Grades of iron ore shipped from the Lake Superior ranges, as listed by the Iron Ore Association for 1937, were 163 in number, each bearing its own particular designation. These are either mined direct or produced synthetically by blending ores of such composition as will give in each case the mixture of the analysis wanted. Comes to mind the day when certain mines on the Menominee sent grades to surface having such fittingly suggestive names as Mars, Jupiter, Pluto, and Vulcan.

▼

Geophysical Work, including prospecting and research, utilizes string galvanometers, into the construction of which enters aluminum wire one ten-thousandth of an inch in diameter and weighing 0.000000009246 lb. per linear foot, so that a pound of it would be 20,000 miles in length. Incidentally, the cost of that same pound would be in the neighborhood of half a million dollars.

▼

Transport by conveyors and trucks in open pits will be discussed by L. C. Moore in the concluding articles of his series, to appear in early issues. As in the preceding articles analyzing the open-pit transport problem, attention will be focused on comparative costs of installation and operation.

▼

Pennies coined by the Mint in the fiscal year ended June 30, 1938, numbered 366,876,920. Subsidiary silver coins numbered 111,754,358, with a face value of $19,854,941. Nickel coinage consisted of 61,744,005 pieces, with a face value slightly less than that of one-cent pieces. Total domestic coin manufactured amounted to 540,375,283 pieces. Coinage for foreign governments amounted to 18,392,444 pieces.

▼

"How should two men carry long and heavy pipe on their shoulders"? queries the National Safety Council *News Letter.* To the proposer of this problem, who seems to be in a quandary about it, we suggest that the two will find it easier if a third man, much taller than they are, is placed between them.

Patent Study—Investigation of the whole patent problem has been started by the National Industrial Conference Board, independent fact-finding organization of management and labor. Technical phases will be supervised by American Engineering Council's committee on patents; the economic aspects will be analysed by the Board's economists, supervised by R. F. Martin. Every phase of the problem will be studied.

H. C. PARMELEE
Editorial Director

Engineering and Mining Journal

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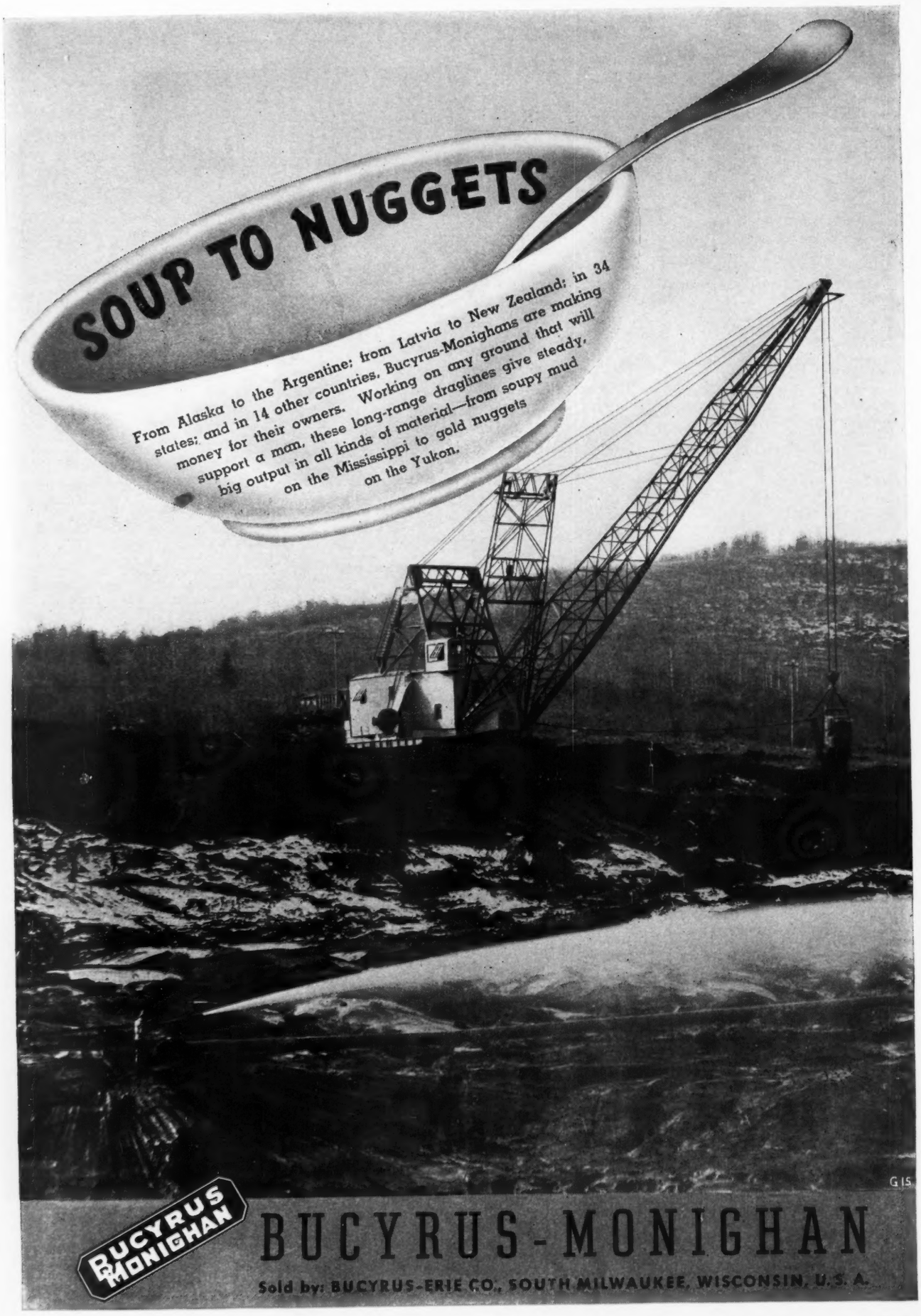
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Volume 140 Number 3

MARCH, 1939

For Better Engineers

IF YOU WERE ASKED to train an engineer for the mineral industries, where would you begin? Probably by selecting a promising youngster in high school. And how would you select him out of a hundred others? Most likely by studying the interests and aptitudes of each and selecting the boy giving greatest promise of success in completing a college course in engineering. In the process you might overlook a potential engineer, and of course your choice might not turn out as well as expected. But you would have followed good engineering procedure in trying to select the best raw material out of which to fashion the finished product. And early in the process, in addition to exploring native ability, you would acquaint the prospect with the nature of engineering work and the standards of the engineering profession.

Toward this objective of student selection and guidance, engineering educators are working through the Engineers' Council for Professional Development, of which the A.I.M.E. is a constituent body. E.C.P.D. is probably best known for its critical study of engineering curricula in the United States, and the publication of an accredited list of institutions prepared to give engineering instruction according to acceptable standards. Greatly to the credit of schools of mines, their curricula withstood critical examination with conspicuous success. But if mining schools are to turn out their best product, they must be supplied with the most promising raw material. Hence the emphasis of engineering educators on student selection and guidance by means of test and counsel.

The field of selection is one for continuing research and experimentation, but enough has already been done to show, for example, that proficiency in mathematics and use of the English language are favorable indicators. Numerous tests are under way to correlate these aptitudes with actual performance in college, and a body of information is being accumulated that must inevitably be helpful and suggestive.

By way of guidance, E.C.P.D. offers to teachers and counsellors a pamphlet entitled "Engineering—A Career, a Culture." More specifically directed to the mineral industries, is a new pamphlet, "Careers in the Mineral Industries," published by the A.I.M.E. Written in question and answer form by Professor T. T. Read, School of Mines, Columbia University, with the cooperation of a special committee, it is addressed to teachers and others who may be called upon to counsel with young men contemplating a career in the mineral industries. Considering the basic inportance of this aspect of engineering education, it is an activity that may well engage the interest of mature engineers, acting individually or through local sections of the A.I.M.E., to the end that better engineers may be trained for the mineral industries.

Plus Values in the Mining Community

THE PAY ENVELOPE doesn't contain all that a man expects to get out of life in a mining community—nor all that a company can put into it. Salaries and wages are compensation for services rendered, but even with a fat pay envelope community life can be pretty drab unless an intelligent effort is made to create conditions that are wholesome and attractive. This is the very essence of public relations in the community in which a mining company is located—a due regard for those intangible elements of life and living that make the pay envelope more satisfactory. In a true sense life begins after the wages and salaries have been earned, and unless there are added satisfactions in surroundings, sociability, recreation, and entertainment, life is likely to bog down to low levels.

In our series of articles on Public Relations for the Mining Industry, we present this month a brief glimpse of Anaconda's community at Great Falls, Montana. It is a pleasing prospect of what a mining company can contribute to life in and about the plant and to the leisure hours of employees. Not from any feeling of paternalism or welfare, but merely as a matter of good business on the part of enlightened management in dealing with human beings. If public relations consists of good manners in business, then any industrial concern owes

something to the life of the community as surely as does the leading citizen. At least it owes good housekeeping. The plant need not be an eyesore, a blot on the landscape. On the contrary, it can easily be beautified to a point where its appearance is a source of pride to employees and an example to the entire community. If in addition to a pleasing prospect at the plant a company can add facilities for social intercourse, the community is twice favored.

Government and Business

WHEN Harry L. Hopkins was appointed Secretary of Commerce there was no little raising of eyebrows in mild surprise, and considerable speculation on the man's fitness for the job. What did a social worker who had been spending billions for relief know about business? Almost immediately the answer began to filter quietly through private channels and later through the press. The new Secretary had specific plans for the benefit of business; had already set himself a five-point task, the accomplishment of which would be his own measure of success as Secretary of Commerce. We ourselves were thus informed, surprisingly enough, by a prominent leader of business men, not a New Dealer, who expressed the opinion that the appointment of Mr. Hopkins was the best political omen for business that had come out of Washington in recent years. The reasons? Mr. Hopkins was personally ambitious for success, intelligent, industrious, and honest. Of all New Dealers he was closest to the President, had his confidence, and would be able to insure sympathetic consideration by the Administration of the attitude and viewpoint of business and industry. He had every incentive not to fail in his new job. Thus ran the grapevine intelligence.

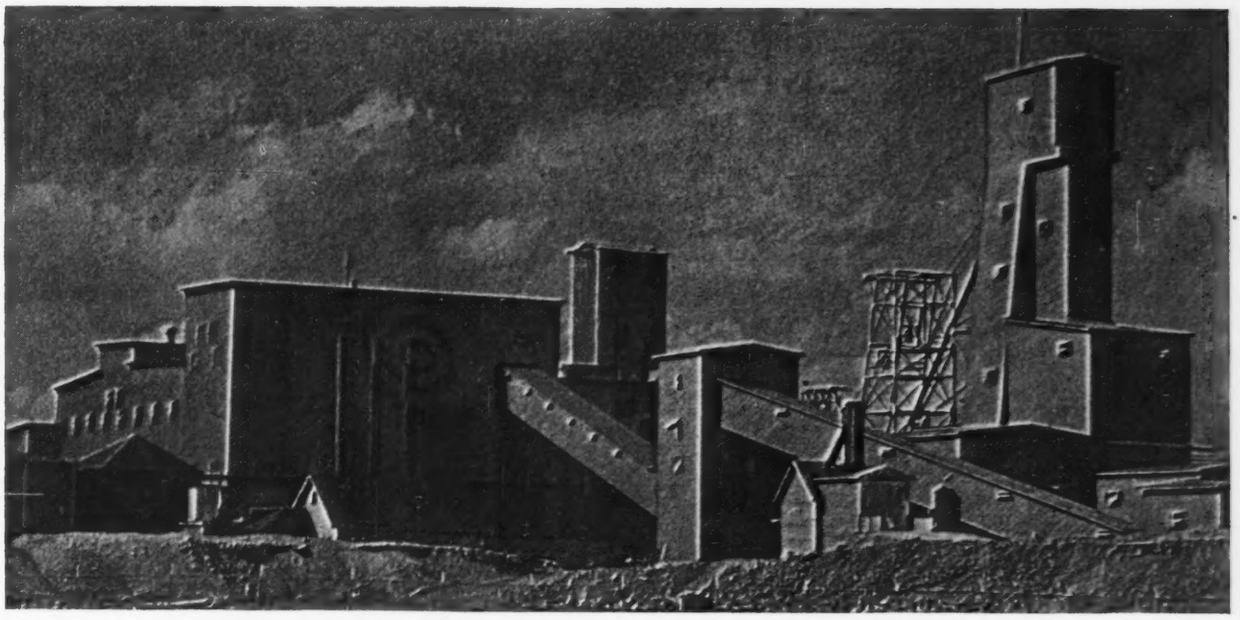
So it was with exceptional interest that the nation waited for Mr. Hopkins' first public utterance on February 24 in his new capacity as the ambassador of business in the Cabinet. Would he measure up to his advance notices? A fair and dispassionate appraisal finds a verdict largely in his favor. He sounded a note of sincerity and sanity in marked contrast to the scolding and name-calling of the President, and the belligerence, arrogance, and truculence of many of the Administration's supporters in office. It was not the kind of speech to which business has become accustomed in the past six years.

Obviously a New Dealer, and defending his philosophy and past record, Mr. Hopkins addressed himself to the sore spots in the current economic situation. He frankly recognized the "widespread lack of confidence" among business men and declined to underrate its importance "as a real deterrent to restored business health." He announced completion of the Administration's reform program, and pledged a determination to promote economic recovery and private employment with all the vigor and power at his command. He affirmed his adherence to the American system of private enterprise, denied a desire to harass and punish business, and disclaimed any quarrel with business merely because it is big. He recognized business success as imperative "if our economic system is to be preserved." Specifically, Mr. Hopkins outlined a program for peace between the utilities and the Government; for unity of labor in the C.I.O. and A. F. of L.; for government aid to small business; for team work between labor and management; for the prosperity of agriculture and the promotion of international trade; for private investment in American industry; and finally for methods of taxation that will not "freeze the necessary flow of capital" into private enterprise.

Will Mr. Hopkins' performance in office measure up to his promise and the hope he has inspired? Does he speak with authority? He should, if on no weaker ground than that of political expediency. It is generally believed that, barring his possible desire for a third term, the President would choose Mr. Hopkins as his successor. Also that the prospect is not displeasing to Mr. Hopkins. If so, nothing could better promote their ambitions than sustained business recovery. But politics aside, the goal is great enough in itself to invite achievement. Actions will now determine whether we are justified in hoping again for the return of an era of good will and cooperation between government and business.

How Long?

IT IS NOT TOO EARLY for those who believe, as we do, that an end should be made to exemption from annual assessment work on unpatented mining claims, to make their wishes known to their Representatives and Senators. Nor is it too soon for those holding such claims to plan to perform assessment work this year without waiting hopefully for further relief from Congress. Even an indulgent government must sometime withdraw its beneficence, and this Congress may be the one to assert its independence and tell claim holders to comply with the law, which, incidentally, requires little enough in return for the privilege of holding mineral land on the public domain.



Wright-Hargreaves
Improves Its Milling Practice

Efficiency and ingenuity mark the operations at its 1,200-ton cyanidation-flotation plant

Malcolm Black
Mill Superintendent
Wright-Hargreaves Mines, Ltd.
Kirkland Lake, Ont.

EXTREMELY high tailing loss in milling seems to have been general throughout the Kirkland Lake district in the early days of operation in this camp of northern Ontario. This fact is attested by the known value of residues deposited in, and still covering, the bed of Kirkland Lake awaiting reclamation at some future date. Fundamentally, all the mines were faced with the same problem, real or imaginary—namely, that of treating sulphotelluride ores successfully. Fortunately, due to the combined efforts of the various mines and the reciprocal cooperation in the exchange of ideas and information, metallurgical conditions have assumed a vastly different aspect in the last few years. The residues are no longer of sufficient value to consider reclamation. Average tailing loss (including dissolved loss) at the mill of Wright-Hargreaves Mines, Ltd., for year 1937 was 0.02052 oz., or $0.425, whereas in 1926 the tailing loss was the highest recorded for the mine at 0.0794 oz., or $1.64. Although a description of the mill as it is at present is the principal object of this article, the inclusion of a brief résumé of early practice conditions out of which the new, well-equipped, and efficient plant evolved may be of interest.

The history of the Wright-Hargreaves mill may be divided into three periods, each exhibiting metallurgical results directly attributable to the existing conditions. This résumé will serve to explain the nature of those conditions and the results obtained from them. The first period, that from 1921 to 1928 inclusive, is not familiar to me or to the present management except from information gleaned from old records. Any remarks regarding the results then obtained are based solely on this information. The second period, 1929-1932, deals also with the original mill, but to which certain changes were made. The third period, 1933-1937 inclusive, has to do exclusively with the new mill.

The First Period, 1921-1928—Operations began in 1921 with a mill of wood construction, designed for 150 tons per day. The flowsheet was typical of several plants of like size in the Kirkland Lake and the Porcupine districts at that time, comprising ball mills in open circuit, followed by tube mills in closed circuit with standard reciprocating rake classifiers, series agitation, and several stages of countercurrent decantation. Referring to the statistical record (Fig. 1), we note that for the first year, the mill treated an average of 150 tons per day. Heads were $14 per ton and the recovery was 93 per cent. (All values quoted in this article are based on gold at $20.67 per ounce.) In the second year (1922) the tonnage was increased to 170 per day. Heads were $12.49 and the recovery was fractionally lower at 92.3 per cent. In my opinion the drop in recovery was due principally to the drop in the grade of the heads. The slight increase in tonnage may also have been a contributing factor. These factors are somewhat more evident in 1923, when the heads were down to $10.48, the tonnage had increased to 215, and the recovery had dropped to 90.8 per cent. So far, it is difficult to find conclusive evidence from the chart

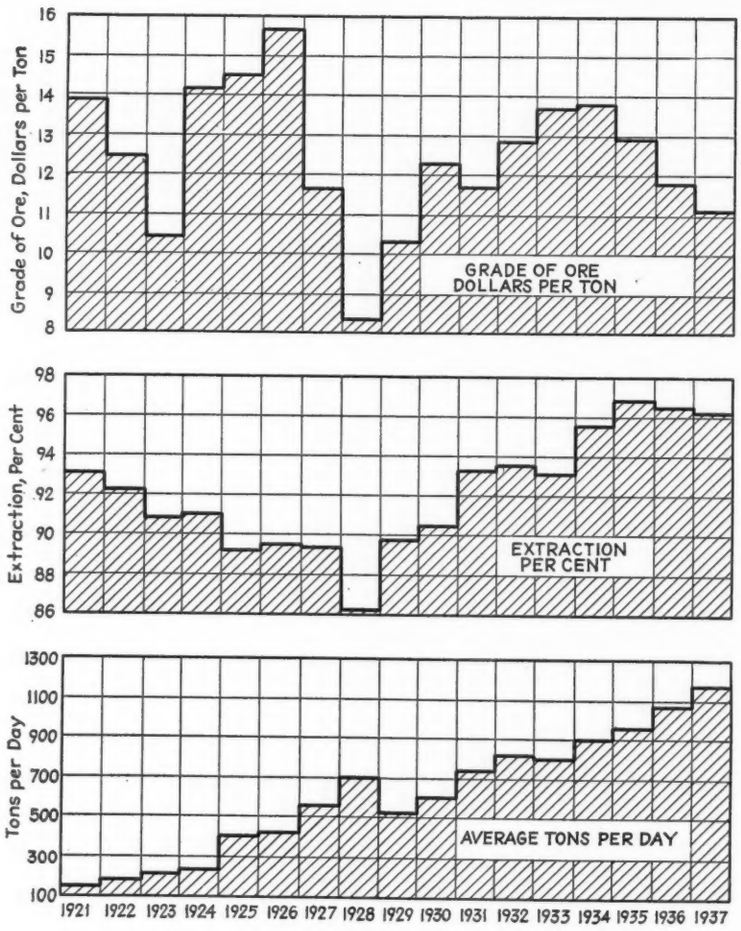


Fig. 1 . . . GRADE of ore treated, percentage extraction obtained, and tonnage milled per day for years 1921-1937 inclusive at Wright-Hargreaves mill are shown by these three graphs respectively

to say definitely whether the increased tonnage or the lower heads, or both, were responsible for the continual decrease in recovery.

The following three years, 1924, 1925, 1926, however, do throw some light on the cause. It will be noted that the grade for those years was the highest in the history of the mine. Also, that the recovery for that period did not respond favorably to that condition. The other factor, that of continual tonnage increase without adequate additions to equipment, seems to have been the predominant reason for the continual decrease in metallurgical efficiency. This fact has been amply substantiated for a number of years and especially during the past five years. The necessity for fine grinding, coupled with prolonged agitation, apparently was not recognized in the early days. As already mentioned, we are dependent on the old records for any deductions made concerning practice prior to 1929. Some of these records are particularly interesting when compared with present-day practice, in that we are able to point conclusively to some of the factors responsible for the continual decrease in metallurgical efficiency for the period ended in 1928. One such record is in the form of a paper written by W. A. Mueller, J. E. Grant, and C. L. Heath for the February, 1926, meeting of the American Institute of Mining and Metallurgical Engineers, and entitled "Treatment of the Telluride-Bearing Gold Ores of the Wright-Hargreaves Mines, Limited"[1].

This paper describes in a general way the practice of that time and the trend of thought governing the practice. The flowsheet, shown here in Fig. 2, is reproduced from this paper. Flotation was added later. In the introduction, the authors state:

"The milling and cyanidation treatment of the ore of the Kirkland Lake district has been very similar to that of other cyanidation plants in the gold districts, but as this mine deepens the ore shows different mineralogical compositions of the gold-bearing constituents. This is especially true of the present, so-called No. 1 vein . . . The uppermost levels of this vein produced an ore in which the values were practically all carried as free gold. With depth tellurides begin to appear, until at the 850 and 1,000 ft. levels the tellurides become very marked and are present in all the ore. . . . The gold occurring as tellurides is but slightly acted upon by the ordinary cyanide treatment and therefore has gradually become an increasing source of loss during the regular cyanide practice."

[1] Issued with *Mining and Metallurgy*, February, 1926.

There is some difference in the concentration of the mineral-bearing constituents in different parts of the mine, but we find this condition applies throughout the whole mine and not particularly to the lower levels. The so-called upper levels are still producing ore. The greater percentage, however, is being produced from levels at a greater depth. So far as the refractory nature of the ore is concerned, we find little, if any, difference from that of the past. It is doubtful that the ore treated in 1921 was free of tellurides. The relative efficiency of the mill at that time was due, in my opinion, to the fact that it was handling a tonnage commensurate with that for which it was designed, and not necessarily because of a less refractory ore. With reference to the statement "the gold occurring as tellurides is but slightly acted upon by the ordinary cyanide treatment," we may interpret this to have at least two meanings: First, that the tellurides are only slightly soluble in the period of time, limited by the size and number of agitators. Second, by changing the phraseology to omit the word "treatment," thereby indicating the necessity for cyanide in another form. The latter is probably correct, as indicated by the fact that when flotation was first introduced in this mill, bromocyanide was used for the treatment of the concentrate.

The circumstances which suggested the original use of flotation in this mill are rather interesting and are mentioned in the paper already referred to. Under the heading "Flotation of Mill Pulp in Cyanide Circuit" we find the following statements:

"The formation of a heavy froth on the surface of the settling tanks and agitators which interferes with the drawing of clear solution, next led to flotation tests being carried out on the mill pulp ahead of the settling tanks. . . During the past year this frothing action of the pulp became very marked and the use of this natural frothing characteristics was relied upon for the flotation."

No evidence is noted in the paper to indicate any attempt at finding the cause of this so-called "natural frothing" condition. The fact that the froth contained a certain amount of gold-bearing tellurides was apparently sufficient justification for the introduction of flotation in the cyanide circuit. As already mentioned, bromocyanide was used for the treatment of the concentrates. The reason given is found under the heading "Treatment of the Concentrate." To quote:

"Tests conducted with those concentrates with the ordinary cyanide solutions show that a good recovery cannot be expected even with continual treat-

ment. . . A recovery of only $5 to $10 could be made on a concentrate assaying $400."

With a similar grade of concentrate today, we find no trouble whatever in producing a recovery of around 98 per cent. To accomplish this, however, the concentrate must be in an extremely fine condition. The concentrate produced in this mill is in the neighborhood of 10 microns. Even at this fineness it requires upwards of 200 hours' agitation for 98 per cent recovery. Dissolution is hastened considerably by the use of excess lime or lead oxide or both. Undoubtedly tests for prolonged periods were conducted on the concentrate, using NaCN as the solvent. The negative results obtained, however, are not recorded. In seeking an explanation for the apparent insolubility it is probably safe to assume that insufficient grinding was a contributing factor.

In our opinion there was an error of judgment in accepting the violent frothing throughout the mill as being natural and making no attempt to investigate the cause and effect. In such a condition there is little chance for the gold-bearing tellurides to be retained in the grinding circuit long enough to receive sufficient comminution for a satisfactory recovery. Tellurides are easily floated, even in an alkaline circuit. Frothing in the classifiers will remove them prematurely from that circuit. Furthermore, frothing in the agitators will tend to hold the rich concentrate in suspension, in which condition it is readily bypassed from that circuit without sufficient subjection to the solvent action of the cyanide.

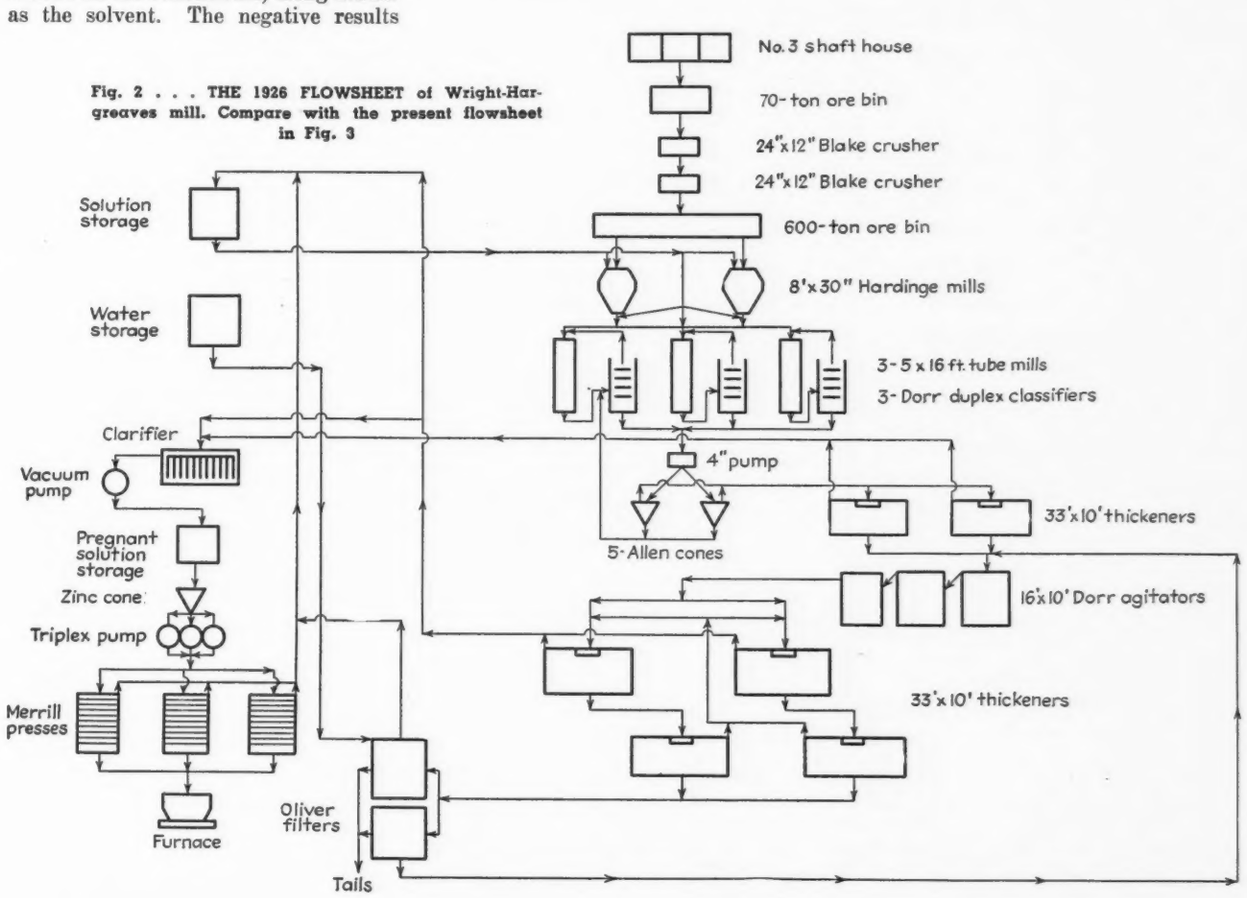
Cause of Excessive Froth — When the present staff took over the plant in 1929, two K.&K. flotation machines were being operated in the cyanide circuit. The concentrate, assaying between $100 and $200 per ton, was led to improvised agitators with covered tops. Bromocyanide was added at intervals until the value was reduced to a few dollars. The contents were then released to the regular circuit. The bromocyanide was made from Dow's Mining Salt, H_2SO_4 and NaCN.

One of the first considerations of the new management was that of improving the grade of ore. To accomplish this, radical changes had to be made in the system of mining the stopes. It was realized that it would take considerable time before the new system could be generally adopted and capable of producing a tonnage similar to that heretofore milled. During the transition period the mill tonnage was therefore reduced from 700 to 500 tons per day. This afforded a splendid opportunity to make certain changes indicated as necessary by current research. This research disclosed the following points: That finer grinding was necessary; that most of the gold-bearing tellurides would definitely give up their value if given sufficient time; that the nature of the ore was not responsible for the violent frothing condition.

The last point was demonstrated by first grinding a sample of the ore in an Abbe mill with freshly made solution, then agitating in a laboratory-size Pachuca designed especially to give a maximum amount of cascading. A similar sample was then given the same treatment, except that mill solution was used in place of fresh solution. This latter sample produced voluminous froth, whereas the former sample produced very little. Other samples were agitated in new solution to which was added a small quantity of gear dressing and other lubricating oils, this producing a froth like that in the mill circuit. It was therefore established that the froth was caused solely by those oils, which, due to the overloading of many bearings, were used in excess. Poorly designed elevators, launders with insufficient slope, and many such factors, were responsible for the excessive spilling of sand on the grinding floor. Whenever this material was cleaned up and returned to the circuit, it added its quota of oil and grease, with the result already outlined.

The new program included the

Fig. 2 . . . THE 1926 FLOWSHEET of Wright-Hargreaves mill. Compare with the present flowsheet in Fig. 3



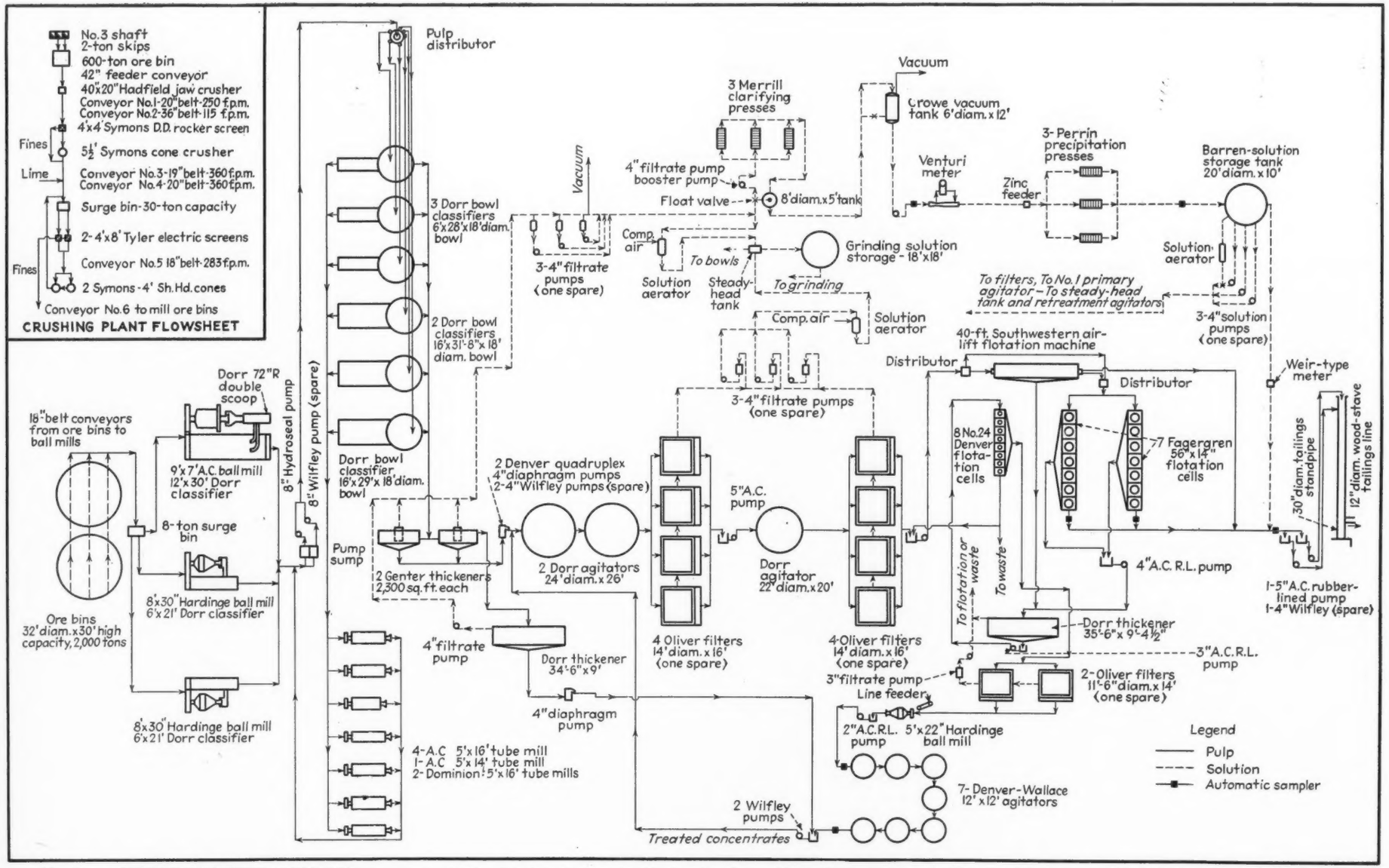


Fig. 3 . . . PRESENT FLOWSHEET of Wright-Hargreaves cyanidation-flotation plant, at Kirkland Lake, Ont., with additions made up to May 2, 1938. The crushing plant flowsheet is also shown

removal of those factors. The open-type gears on the ball mills and the tube mills were provided with suitable covers and drip catchers. Oil-ring bearings on the pinion shafts of the Hardinge mills, which consumed large quantities of oil, were replaced with heavy roller bearings. New equipment was added, including three 18-ft. bowl classifiers, which replaced the old standard-type machines; two 24x26-ft. agitators, and two 14x16-ft. Oliver filters. Under the new conditions, the amount of froth lessened markedly. The gold-bearing tellurides leaving the classifiers were in a much finer state, in which condition bromocyanide was no longer required. Flotation as formerly practiced was therefore discontinued.

During 1932 the mill handled 800 tons per day. The grade, through the new system of mining, had been raised to $12.85 and the recovery to 93.4 per cent. By this time, the mine was developed to the point where existence of a much larger tonnage was indicated. The decision was therefore made to equip the mill to handle 1,000 tons per day and to leave room for a possible further increase later to 1,200 tons. Several important factors had to be considered. The mill roof and the supporting timbers were badly rotted from winter sweating. The floor space was already overcrowded, and the building was hemmed in on all sides, leaving space for additional grinding only. It was therefore necessary to work out a flowsheet that would not only improve the metallurgy but would also suit the limited space available.

A small pilot plant was built adjacent to the mill, and experiments on various flowsheets were carried out by the late H. Vincent Wallace. As conservation of space was of prime importance, experiments with flotation received the most attention, because the resulting concentrates would require much less space for agitation. The procedure previously followed, that of floating in an alkaline cyanide circuit, was investigated, but found inefficient due to the inhibiting action of the excess lime and cyanide. A similar pulp after washing and conditioning with the proper reagents yielded much better results. This system was therefore adopted. For the purpose of those experiments, pulp was drawn from various places in the mill circuit. It was found that the best over-all results obtained when the pulp was taken from a point where the extraction curve began to flatten out; that is, after the readily dissolved gold had been taken into solution. Encouraging results were obtained with the agitation of concentrate in cyanide and high lime, this pointing conclusively to the possibility of making a substantial saving in the space required for agitation.

THE CONVEYORS that feed the three ball mills respectively from the surge bin are each provided with the device here shown, which operates a horn alarm in case the feed from the surge tank fails, as when a chute is blocked

To permit further saving of space, Genter thickeners were chosen in place of the much larger gravity-type thickeners. It will be noted in the graph in Fig. 1 that, in 1933, the extraction and tonnage fell off slightly. This was due entirely to operating difficulties imposed during the building period. On the plans for the new building many of the steel columns were located on space already occupied by thickeners, agitators, and other vital equipment. In some cases, these had to be removed before other equipment intended to take their place was installed.

By the end of 1933, the new mill was completed. A description of it is given in the following: The building is of steel construction. The walls are covered with 1¾x12-in. Douglas fir shiplap, and ½ in. of Celotex. Outside covering is Johns Manville Hex rigid asbestos shingles. The roof is made up as follows: To the purlin is fastened 2x6-in. nailing strips, then 2¾x12-in. Douglas fir shiplap, ½ in. of Celotex, a layer of 1¾x12-in. shiplap, another ½ in. of Celotex, and, finally, a layer of twenty-year built-up roofing. The two layers of Celotex were mopped in with asphalt. This may be considered somewhat elaborate, but we find such a roof necessary to prevent the ravages of winter sweating. The building is heated in winter by steam unit heaters. Fire protection is provided by the sprinkler system.

Crushing—The crushing plant is housed in a separate building, the crushed ore being transported to the mill bins on a covered-in conveyor. The ore, after passing a 10 in. grizzly underground, is hoisted in 4-ton skips, and automatically dumped into a 500-ton steel bin. It next passes by means of a 42-in. ratchet-actuated conveyor to a 40x20-in. Hadfields jaw crusher, set at approximately 3½-in. ring size. A suspended magnet removes tramp steel at this point. The primary crusher product is conveyed first on a 24-in. belt traveling at 250 f.p.m. and then transferred to a 36-in. belt traveling at 100 f.p.m. The purpose of this wide slowly moving belt is to allow the removal of pieces of wood which come up with the ore in large quantity. Next, the ore passes on to a 4x4-ft. Symons D.D. rocker screen. The top screen has openings 1x2-in., and the bottom screen ½x1-in. openings. The oversize passes directly to a 5½-ft. Symons standard cone crusher driven by a 150-hp. motor. The fines are bypassed to meet the crusher product. Removal of fines at this point helps materially in crusher operation.

The crushed product is conveyed first on a 19-in. belt at 360 f.p.m. and transferred to a 20-in. belt conveyor running at the same speed. Those belts are designed in a switch-back fashion for the purpose of gaining elevation to a 30-ton steel surge bin. This bin discharges through roll-controlled chutes to two 4x8-ft. Tyler electric vibrating screens, Type 400, with screen opening of 0.270 in. by 3⅛ in., and set at an angle of 34 deg. from the horizontal. The fines pass directly to the mill bin conveyor, and the oversize goes to two 4 ft. Symons Short Head cone crushers. The Short Head product is returned to the surge bin.

The crushing plant has a capacity of 100 tons per hour at the present fineness. All conveyors are equipped with roller-bearing troughing and return idlers. Several self-aligning troughing idlers are placed on each conveyor. The total cost of crushing in 1937 was $0.105 per ton, made up as follows: Labor, 3.6¢.; supplies, 4.4¢.; power, 2.5¢.

The final crushed product is conveyed to the mill bins by an 18-in. conveyor belt running at 250 f.p.m.

on an angle of about 18 deg., driven by a 15-hp. motor through a worm-gear reduction. Tonnage is measured on this belt by means of a sintering Transportometer. The two mill bins are of steel, 32 ft. in diameter by 30 ft. high, cylindrical in shape, and holding 1,000 tons each. In an effort to eliminate as much dead space as possible, the bin floors were designed with three 3-ft. steps, so that, the tops being level, the height at one side is 30 ft., at the center 27 ft., and at the other side 24 ft. A conveyor runs under each of the three steps for the length of the two bins.

Each bin has ten 14x16-in. discharge chutes, three for each outside step and four in the center. These conveyors are operated from a line shaft, each having an individual clutch, so that all or any one may be operated. The motor driving this line shaft is controlled by means of a photo-electric cell (further reference to which will be made later). The three bin conveyors, each at different elevations, discharge on to a fourth conveyor set at an incline corresponding to the difference in elevation. One more transfer and the ore discharges into a 6-ton surge bin, from the bottom of which the three ball mills are fed by individual conveyors, the feed to each being controlled by chutes fitted with adjustable gates.

The tonnage delivered to each ball mill is measured by two factors, a revolution counter and the weight of a section of the belt load. The cutter used to remove this consists of two parallel plates attached to and rigidly held by a crossbar. The distance between plates is equal to one-fifth of a revolution of the head pulley. In taking the belt weight sample, the conveyor is stopped, the cutter placed down on the belt, and the ore between the plates carefully brushed off into a pan and weighed. This is done every hour. The sample is then passed through a Jones sampler until about ½ lb. is left. Determination of moisture is made before the ore has a chance to dry in the air. At the end of each day, the composite sample is again cut down and sent to the assay office. The assay, times tonnage, minus moisture, represents the value delivered to mill. This, however, is taken only as a check, the precipitation plus the tails value being used for ascertaining production for record.

Without some means of automatic control, it would be difficult for the operators to adjust the feed coming in to the surge bin so as to equal exactly the amount leaving the bin. Through co-operation with the electrical department, however, a simple, efficient method was evolved. This involves the use of a photo-electric cell placed on top of and at one side of the bin and directly opposite a light source. When the ore builds up to a point where the light ray is intercepted, the power is automatically cut off from the motor already mentioned. It is necessary, of course, to adjust the feed so that slightly more is coming to the bin than is leaving.

The apparatus required in connection with this photo-electric cell is as follows: A 110-volt transformer to supply power to the light source; an amplifier to build up the energy of the photo-electric cell sufficiently to operate a relay (G.E. CR 7505-KI); a G.E. motorized time-delay Type MC11 relay; a single-pole relay to operate the 550-volt contacts; a double-voltage relay used with 550 volts on the operating coil and 550 volts on the relay contacts; also two bypass switches wired for bypassing the relays for manual operation and one switch for opening the control circuit to stop operation and start up, at the conveyor head. Operation is as follows:

With no power on the circuits, the coil circuit of the conveyor starter is de-energized and the conveyor is down. When the control circuit is energized, the photo-electric cell receives light from the light source, causing the amplifier to operate its relay, thereby energizing the Type MC11 motorized relay. After a predetermined time (adjustable, and in this case three-fourths of a minute), the Type MC11 relay, after the time delay, energizes the operating coils of the double-voltage relay (CR 2821), the contacts of which close the operating coil circuit of the conveyor starter and start the conveyor. When the mill feed rises in the surge bin sufficiently to intercept the light beam, the photo-electric cell becomes de-energized and through its relays shuts down the conveyor. When light is restored, the relays operate to energize the Type MC11 relay again, and this, after the time delay, starts the conveyor. The purpose of the Type MC11 relay is to delay the re-starting of the conveyor too frequently, as would happen if it were controlled entirely by the rise and fall of the ore in the bin.

Each of the ball-mill feed conveyors is equipped with an electrically operated alarm placed near the surge bin discharge chutes for the purpose of warning the operator of chute blockage (see the photograph). The Mercoid control which we use in each case is No. 848-X, Type 3078433, Serial No. 99780, range 122-195 deg. F., voltage 110 and 120; amperes 10 and 5. In using this relay for conveyor alarms, a steel arm with a rubber-padded end rests on the conveyor load with the Mercoid control (less the temperature parts) mounted on the arm and adjustable to any level. When the flow of feed stops, the arm drops down and the mercury in the control flows down to make contact for the horn.

An alarm of another type and for a different purpose may also be described at this point. Alarm stations are placed throughout the mill for use in summoning help in an emergency. At each station there is a pushbutton which operates a horn and a flash light. A separate signal is designated for each station and a list of these is hung near by. When the signal is given, it is sounded at each station in the mill. It is the duty of the shift boss or the solution man to rush immediately to the station issuing the signal. Because of the rapidity with which attention is thus drawn to the seat of trouble, the use of this device facilitates continuity of operation.

(*To be continued*)

▼ ▼ ▼

Calcium Sulphate Eliminated From Cyanide Solution

AN INGENIOUS METHOD of removing troublesome calcium sulphate from cyanide solution is described in the Dec. 10, 1938, issue of *Chemical Engineering & Mining Review,* Melbourne, Australia, by H. J. Harrison, metallurgist, Loloma (Fiji) Gold Mines, Vatukoula, Fiji Islands. Ore treatment at the Loloma mine consists of cyaniding roasted ore. The formation of calcium sulphate appears unavoidable, and varies with the amount of calcite in the ore. At times this compound crystallized out of solution, closing pipe lines, cementing around the circumference of the thickener, and accumulating in clarifier leaves and in the precipitation press. Could these crystals be induced to form where they would do no harm and be readily removed?

The answer was found by suspending discarded clarifying leaves in the barren-solution tank containing clear solution from the Merrill-Crowe plant. They were quickly coated with clear crystals. The success of this experiment having been demonstrated, the following procedure was adopted and has now been in operation for several months: Strips of calico are suspended in the barren-solution tank, spaced about 4 in. apart and reaching to within 2 ft. of the bottom. When a crop of crystals has accumulated, the cloths are removed and cleaned. Since adopting this practice, all troubles due to calcium sulphate have disappeared. Time of clean-up has been reduced by half, zinc consumption is light, effluent from the precipitation press is practically barren, and the gold carries less than 1 per cent of base materials.

MakingEmploymentAttractive

At Anaconda's Great Falls Plant

Welfare and safety are major considerations of the management

Albert E. Wiggin
Manager of Reduction Departments
Anaconda Copper Mining Company
Great Falls, Mont.

PUBLIC RELATIONS for THE MINING INDUSTRY

FOR years it has been the aim of the management of the Great Falls plant of the Anaconda Copper Mining Company to make all conditions surrounding employment not only as safe as possible, but also as attractive as possible, to the end that a job at this plant may be as desirable as it can be made.

The plant is situated about two miles northeast of the city of Great Falls, Mont. Its surroundings have been made attractive by landscaping, including 64½ acres of parks, with trees, shrubs, flower gardens, fountains, and lily ponds. During the summer the employees enjoy eating their lunches on the grass under the trees. At Christmas thousands of colored lights, suspended on the hundreds of evergreen trees, turn the plant into a Christmas fairyland, which affords pleasure not only to employees but to others. Many townspeople, together with employees, drive through the grounds during the summer to view the landscaping. An arrowhead tulip bed, containing over 5,000 bulbs, attracted much attention and gave pleasure to many employees and others during the past summer.

A brief description of some of the human activities at the plant should be of interest. Under normal conditions, there are about 1,500 employees at this plant.

The A. C. M. Club was organized about twenty years ago. Membership is open to any employee, dues being 50c. per month. The clubhouse is near the entrance to the plant and houses six bowling alleys, a pool and billiard room, three horseshoe courts, a rifle range, a library and reading room, and a commissary. In addition to the activities which take place in the main clubhouse, there are two standard tennis courts, a nine-hole golf course, a skating pond, and a swimming pool. A small clubhouse at the golf course provides a meeting place for the golfers, with a chance for rest and refreshment. There is also a change house at the golf course, with lockers and showers.

During the year smokers and entertainments are held which enjoy an average attendance of six hundred employees and friends. Luncheon is always served on these occasions. Business and professional men from Great Falls are invited to attend and thus become acquainted with the plant employees. Much interest is manifested in all the club activities, but particularly in bowling and golf. Provision is made for the members of the employees' families to use the bowling, golf, tennis, and swimming facilities.

A cooperative plan with the Y.M.C.A. in Great Falls makes it possible for an A. C. M. member to become a member of the "Y" by paying an additional $4 per year.

Teams from the plant participate in baseball, softball, and basket-ball leagues comprised of city and plant teams under the direction of the Great Falls Recreational Association.

As the name implies, the purpose of the safety department is to provide working conditions as safe and healthful as possible. The work is carried on under the direction of the head first-aid man, aided by two assistants. Safety committees function in all departments and suggestions are taken care of promptly. Committee members are chosen to represent all phases of the work in each department, and the membership is changed from time to time.

The plant, seen from the air

So far as possible, hazards of work are eliminated by mechanical safeguards and by personal safeguards, such as safety shoes, goggles, and respirators. We also strive to make the employees safety-conscious at all times, as we find that most accidents result from lapse of mental alertness on the part of the employee. We have also found that first-aid training tends to make an employee more careful, and our accident rate is appreciably lower among those employees who have had such training. When it becomes necessary to employ an appreciable proportion of new men who are not familiar with the working conditions, we find that our accident rate rises. The older employees have always shown a splendid disposition to help the newer men in every way, but the higher accident rate among new men is a problem which we have not as yet solved to our satisfaction.

Four well-equipped first-aid stations are maintained at the plant, and three first-aid men are on duty for treatment of injuries or sickness. Employees are encouraged to go to these men no matter how slight an injury may be. All three of the first-aid men reside at the plant and can be called whenever needed during the night. A modern ambulance is kept at the plant for transporting seriously injured or sick. Ambulance service is supplied for employees and members of their families at their homes without charge.

Large cabinets, each containing a stretcher, a complete set of splints, blankets, and a portable first-aid kit, are placed at various points about the plant for emergency use. All tramming motors, hoists, and cranes are equipped with emergency first-aid kits. Foremen are required to take a course in first-aid training. We consider that the safety and welfare of his men is a foreman's first duty.

The first-aid staff trains employees in first-aid as standardized by the United States Bureau of Mines. The company endeavors to keep foremen and workmen trained in all departments and on all shifts. To accomplish this, lectures on first-aid fundamentals are given at safety meetings and complete first-aid courses for department heads and foremen are conducted during the winter. Further to promote efficiency, many first-aid teams of six men each are organized early each year and are given intensive training in preparation for contests to be held during the summer. The teams meet on an appointed day, usually late in June, for the contest, which attracts a large attendance of employees and others. They are observed closely and rated carefully by competent judges. They attain such efficiency that there is little difference between many of them in the quality of their performance. Rivalry for prizes is keen, and the teams attaining highest ratings here are entered in State and in International contests which are held under the supervision of the United States Bureau of Mines and in which Great Falls teams have won highest honors several times. At present, about one-third of the employees are well trained in first-aid.

Medical, hospital, and surgical treatment is available for employees and for members of their families. Four doctors and an industrial nurse and two large, modern hospitals are provided. The patient has a choice of hospitals and may also employ a doctor outside the staff by paying him and at the same time receive all of the medical and hospital benefits under the contract. For this service, the employees pay $1 per month, if without

dependents, and a total of $2 per month if with dependents. X-ray service for either diagnosis or treatment is included. For a confinement case, a charge of $12.50 is made by the doctor, two-thirds of the normal charge for hospital room and board is made by the hospital.

A trained graduate nurse is employed by the company and works with the doctors in providing service for employees and members of their families. Her time during the forenoon is devoted to visits to the home, and during the afternoon she maintains a baby clinic at the doctor's office, to which any employee may bring his baby for observation and treatment without charge. This so-called industrial nursing has proved to be one of our best activities during the fifteen years it has been in service. For example, during 1938 the following service was rendered:

Nursing	
House calls	944
Total patients	484
Men	33
Women	173
Pre-school children	185
School children	93
Baby Clinic	
Babies cared for	65
Baby clinics held	244

As to general welfare, four modern change houses are maintained at convenient locations for the men. These have steel clothes lockers and the most modern washing, bathing, and toilet facilities. Janitor service is provided sufficient to keep the houses clean and sanitary.

Electric refrigerated filtered city water is supplied to all departments for drinking purposes. The general office building, which houses the purchasing, accounting, engineering, traffic, and local executive departments, is air-conditioned. Commissaries, where the employees may obtain milk, ice cream, lunch staples, candy, cigarets, cigars and tobacco, are maintained at several points about the plant. General welfare is considered at the safety meetings.

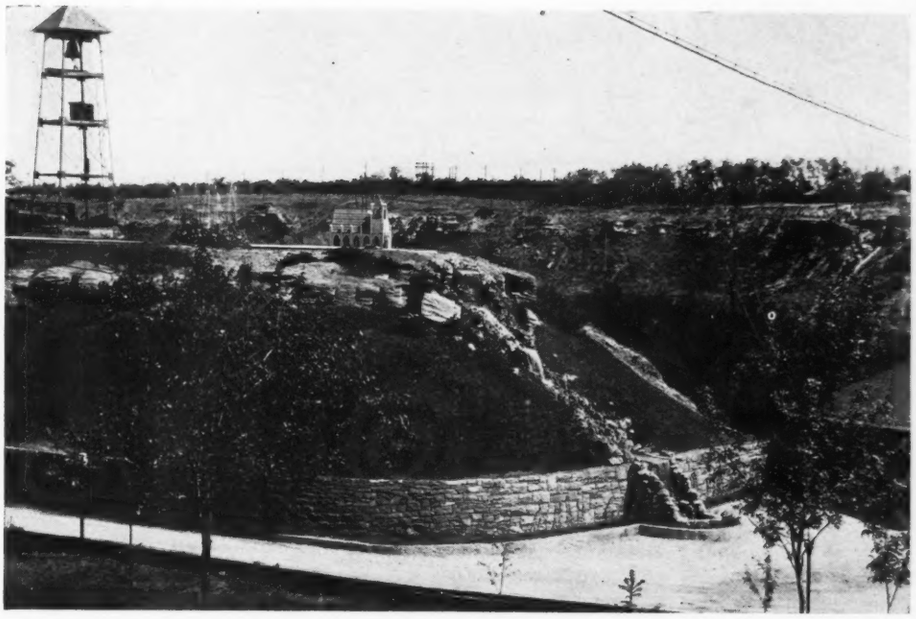
Meetings of the department heads and assistants are held each month at the A. C. M. clubhouse, at which operating costs, accident records, and matters pertaining to safety and welfare are discussed. These meetings follow a luncheon, to which business and professional men from Great Falls are invited, thus bringing into contact those concerned with the interests of the plant and the city interests. Following the business, a talk is made by some interesting speaker.

Employees have an organization known as the Mutual Death Benefit Association, every member of which pledges to pay one dollar to the beneficiary on the death of any member of the association. Participation is entirely voluntary. Normally there are approximately 800 members. The company pays the beneficiary immediately following the death and then makes the deductions from the payroll.

Group life insurance is provided by the Anaconda company for each of its employees who cares to participate. The cost is divided between company and employee. Ninety-eight or more per cent of the Great Falls employees carry this insurance.

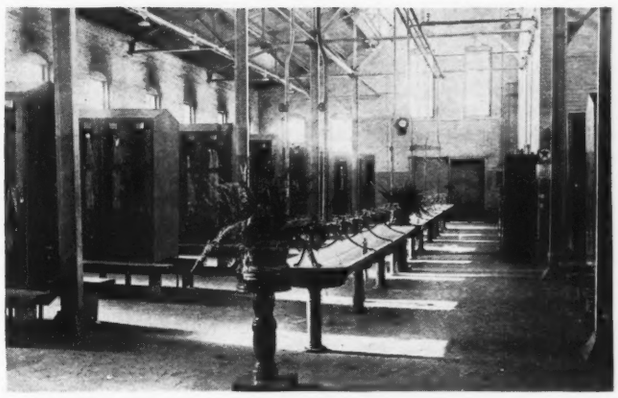
As for public relations, the Anaconda company, as well as the individual employees, takes much pride in the community and manifests its interest in as many helpful ways as possible. Financial aid, as well as individual help, is given to most movements in the city which make for better conditions. Employees of the company are found participating actively in the Community Chest, Chamber of Commerce, Y.M.C.A., the churches, in the Boy Scouts, Girl Scouts, Camp Fire Girls, Catholic Youth Council, and all other worthy enterprises. Our first-aid department gives instructions to the city police and firemen and to the pupils in the school system, as well as to various troops of Scouts. Members of the various civic clubs in Great Falls are entertained at the club.

The National flag is flown every day at three points in the plant, being raised at sunrise and lowered at sunset.

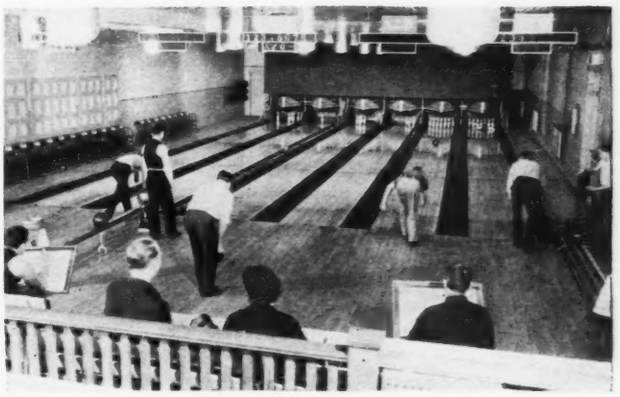


The entrance to the Great Falls plant

At Great Falls



In the change house of the copper refineries



Bowling at the A.C.M. Club

Contests in first-aid work are held outdoors

The first-aid station that serves the shops

Swimming in the A.C.M. Club's pool

Again the Question of Assessment Work!

Suspended for seven consecutive years, shall the legal requirement be waived once more in 1939?

A. H. Hubbell
Associate Editor

THE next few months will unquestionably witness fresh recurrence of clamor for suspension of the legal requirement as to performance of assessment work on mining claims during the twelve months ending at noon on July 1, 1939. In fact it may be said to have already begun, inasmuch as House Resolution 3818 and Senate Bill 1288, providing for such suspension, have already been introduced at Washington. Unless Congress takes a firmer stand than it has taken in the last few years, one may expect to see suspension again authorized, at least for the same class of claim holders that has enjoyed it for several years past, and with similar provisos. Claim holders are numerous and vocal. Those opposed to continuance of suspension usually have succeeded in impressing their views on Congress only after long delay.

Simplicity characterizes the assessment work provision of the United States mining law. As provided in Sec. 2324 of the Revised Statutes, it is, in brief, that on each mining claim located (discovery of mineral being prerequisite to such location), and until a patent has been issued therefor, not less than $100 worth of labor must be performed or improvements aggregating such amount must be made each year, and that "proof" of such performance shall be filed in the office where the notice of location is recorded. This "proof" consists of an affidavit. Compliance with this requirement, once the notice of location has been recorded in accordance with the law, gives the locator property rights recognized by the courts. The locator may subsequently patent the claim, if he wishes, on compliance with further provisions of the law, but a patent is not necessary to insure to him the property rights mentioned. In view of such liberality, the assessment work requirement is hardly unreasonable. That it be complied with in good faith is essential if the existing vast acreage of unpatented mining claims is not to be left in the possession of those who are either unwilling or unable to prospect and develop them.

Exceptional circumstances may warrant suspension of the work requirement, as, for example, when claim holders were drafted for military service during the World War, so that compliance with the law was made impossible for them except for those who could get someone to do the work. Depressions may likewise work injustice, though here the justification for suspension is less well defined. Experience, however, has shown that any willingness of Congress to be lenient is likely to be abused. Once granted, suspension has tended to become perennial and is checked in this course only with great difficulty. The basic purpose of the law, it should be remembered, is to promote development of the public mineral lands and not to preserve individuals in the private possession of them.

Some Historical Facts

Suspension of the assessment work requirement was first authorized by Congress on Nov. 3, 1893, when it was made effective for that year, save in the State of South Dakota, without other proviso than that the claimant file a notice of intention to hold and work his claim. On July 18, the following year, it was authorized for 1894, the prevailing hard times doubtless furnishing the motive. This ended it, hearts apparently beating less high for the "forgotten man" in that more rugged day.

The next recorded instance of suspension is found when Congress on Dec. 1, 1913, authorized it for the benefit of those holding claims on the Seward Peninsula, Alaska, with respect to the work required for that year, provided that in each case a notice to hold or work the claim were duly filed.

Not until after the United States had entered the World War was the work requirement again suspended and then only for the benefit of claim holders serving in the Army or Navy during the War and either during their period of service or until six months after their death in service or after being mustered out of it, with the proviso that notice to hold or work their respective claims should be duly filed. This action was taken on July 17, 1917. On Oct. 5 of that year, without repealing the foregoing enactment in any way, the privilege was extended to all holders of claims (without mention of those in Alaska), with the same proviso, but specifically for the assessment work years 1917 and 1918, the reason given being that labor might thereby be most effectively used in raising and producing things needed in prosecuting the War. "Oil placer" locations or claims were excepted. The privilege was subsequently extended specifically to all claim holders in Alaska for these two years, and the year 1919 was added, by action of Congress on Feb. 28, 1919. Later in that year, on Nov. 13, all other holders of claims were granted suspension for the year 1919, provided notice of desire to hold a claim were filed.

In the succeeding years, despite agitation, no further suspension of assessment work was granted to any claimants whatever by reason of conditions growing out of the now-ended War. The time for doing the assessment work for 1920 in the United States and Alaska was, however, extended on Dec. 31, 1920, for six months, or from Dec. 31, midnight, 1920, "to and including" July 1, 1921, this without changing the existing law respecting assessment work to be done for the year 1921. Had this remained unchanged, the assessment work required for 1921 would have had to be completed by midnight, Dec. 31, 1921. However, on Aug. 24, 1921, Congress by enactment changed the assessment work year from the calendar year, making it coincide with the fiscal year, or from noon, July 1, 1921, to noon July 1, 1922, and similarly for each succeeding year thereafter,

as it remains up to the present time.

Agitation for suspension of annual assessment work again became manifest in 1932, with the deepening of the depression, and Congress was persuaded once more to authorize it. That year, and the subsequent ones up to and including 1938, have each seen an act passed by both House and Senate and approved by the President, suspending the legal requirement for the respective fiscal twelve-month period ending in that year. In order, these are as follows:

1932. Public Resolution No. 23, approved June 6. Suspension authorized on *all* claims in United States, including Alaska, for the year July 1, 1931-July 1, 1932. No notice of desire to hold required.

1933. Act of May 18, 1933, Public No. 18. Suspension authorized on *all* claims in United States, including Alaska, for year July 1, 1932-July 1, 1933, for all claimants exempt from payment of Federal income tax for 1932. A notice of such exemption and of desire to hold claim required.

1934. Act of May 15, 1934, Public No. 226. Suspension authorized for United States, including Alaska, for year July 1, 1933-July 1, 1934, for all claimants exempt from payment of Federal income tax for 1933. Notice had to be filed. Number of claims to which suspension applied limited.

1935. Act of June 13, 1935, Public No. 129. Suspension authorized on all claims in the United States *but not in Alaska* for year July 1, 1934-July 1, 1935, for all claimants exempt from payment of Federal income tax for 1934. Notice had to be filed. Number of claims limited.

1936. Act of April 24, 1936, Public No. 532. Suspension authorized for all claims in United States, *not* including Alaska, for year July 1, 1935-July 1, 1936, for all claimants exempt from payment of Federal income tax for 1935. Notice had to be filed. Number of claims limited.

1937. Act of June 24, 1937, Public No. 161. Suspension authorized for all claims in United States, *not* including Alaska, for year July 1, 1936-July 1, 1937, for all claimants exempt from payment of Federal income tax for 1936. Notice had to be filed. Number of claims limited.

1938. Act of June 29, 1938. Public No. 781. Suspension authorized for all claims in United States, *including* Alaska, for year July 1, 1937-July 1, 1938, for all claimants exempt from payment of Federal income tax for 1937. Notice of such exemption and of desire to hold required. Number of claims limited.

In the foregoing list, one should note that Alaska was included in granting suspension in the laws of 1932, 1933, and 1934, excluded in the laws of 1935, 1936, and 1937, and again included in the law of 1938, the latter evidently being due to the recession in business recovery that set in in the latter half of 1937. So far as the United States proper is concerned, however, claim holders of the specified class have been excused from performance of any assessment work for no less than seven successive years. Beginning with the law of 1934, the number of claims to which such suspension applied was limited, the law reading:

"Such suspension . . . shall not apply to more than six lode-mining claims held by the same person, nor to more than twelve lode-mining claims held by the same partnership, association, or corporation . . . to more than six placer-mining claims not to exceed 120 acres (in all) held by the same person, nor to more than twelve placer-mining claims not to exceed 240 acres (in all) held by the same partnership, association, or corporation."

Proposals to suspend the assessment work requirement met with strong opposition in the past. Whether it materialized at the time of the earlier instances cited—namely, in 1893 and '94—or in the case of the claims on the Seward Peninsula in 1913, does not appear in the records at hand. During the War period and in the following year, the exemption of claim holders not in service was authorized only after prolonged argument by opponents. Current objections to the further authorization of suspension are made on several grounds, although the arguments differ little from the earlier ones. They are summarized in the following paragraphs.

Opponents argue that the law as drawn is meant to encourage the development of the natural resources on the public mineral lands and is purposely made liberal. Simply by fulfilling its easy terms the claim holder wins the legal right to work his piece of ground that may eventually yield him anything from day's wages to a fortune. No tax is involved; instead, merely the county recorder's fee incidental to filing an affidavit that the annual assessment work has been performed. But when suspension is authorized, work is stopped, at least by those that have sought suspension, and the claim holder becomes a "claim sitter," who cannot or will not attempt to develop his ground. In fact, suspension makes it possible for one who has no intention of doing work at all to file on claims and retain them for speculative purposes, keeping prospectors of good intent off the ground and also others who have the will and means to work it, suspension or no suspension. Companies and individuals are, moreover, thus enabled to retain possession of holdings of a size out of proportion to their means for working them. Thus, inactivity is encouraged instead of the opening of new prospects, and the development of new mines, so necessary to the industry, is thereby deferred.

Advocates of suspension in the past have sought it for the most plausible reason, now on the ground that labor was scarce, now because times were hard, although in the latter instances labor was plentiful and cheap. Certainly such is the condition today. Indeed many a *bona fide* prospector would be glad of the chance to do $100 worth of work of the kind he finds so natural, thereby to aid him in prospecting further on his own account.

The very purpose of the law is at variance with the idea of long-continued suspension. Development of the country's natural resources is a matter of sufficient importance for the Government to be practical about it rather than sentimental. Perhaps it was desirable indeed to authorize suspension in 1932. But lenieney has since been extended for six years more to claim holders of limited financial means, and the time has arrived when they should be asked to relinquish their holdings to others better able to develop them, if they are still unable to do their assessment work or to pay for having it done. It would be well for the mining industry, indeed, if the regulations were tightened, so as to leave the maximum amount of ground open for prospecting.

Suspension in Dominion Rare

In Canada, it may be noted, the assessment work requirements have never been suspended by either the Dominion Government or the Government of any of the Provinces, nor has the time been extended, save in the following instances. During the World War the Province of Ontario issued an Order-in-Council in both 1917 and 1918 providing an extension of twelve months for the completion of work due in each year, presumably because in those War years many claim owners were overseas. Likewise in British Columbia the property of all who enlisted, whether mineral land or of other sort, was protected during the respective period of service. In the Northwest Territories, Section 52 of the Dominion Government's "regulation for the disposal of quartz mining claims on the Dominion lands" in that area, which section prescribes the work requirements among other stipulations, was suspended from June 24, 1931, to Oct. 1, 1933, owing to conditions of remoteness and lack of transportation, as well as to the market conditions then prevailing, which rendered the development of mining properties inadvisable at the time. And, finally, in Manitoba, the assessment work requirement was suspended for one year only—namely, for the twelve months ended Feb. 29, 1932, since when the time in which work had to be performed has been extended on certain occasions, but never for longer than six months.

Back of the immediate question as

Calculation of the Niter
In a Sulphide Ore Assay

Leslie L. Motz
Assayer, State Assay Laboratory
Baker, Oregon

A CERTAIN AMOUNT of guesswork is involved in determining the niter required in a sulphide ore assay. The method usually employed, when a preliminary sulphide assay is not run, is based upon the assayer's estimate of the sulphur content of the ore and his experience in running similar ores.

Many complex sulphide ores are met in the work of the State Assay Laboratory of the State Department of Geology and Mineral Industries at Baker, Ore.; and the niter necessary to oxidize the sulphur in excess of that required to reduce a 25-gram lead button has previously been computed from an estimate of the sulphide minerals present in the ore. In an effort to add to the certainty of success of the sulphide ore assays, the accompanying chart was devised.

Nearly pure specimens of the sulphide mineral occurring most frequently in the ore deposits of eastern Oregon were obtained and their reducing powers were determined by the usual fusion method. The accompanying table lists these minerals and their reducing powers in three groups according to the value of their reducing powers. Their reducing powers do not check with calculated values, because, for the purpose of the laboratory study, pure minerals were not taken. The reducing power of the flour used in the laboratory is 10.0, and the oxidizing power of the niter is 4.2. These data were used in the construction of the chart so that each of the three curves is nearly the average of the reducing powers of the corresponding mineral groups. The chart is used with the standard assay charge with 0.5 A. T. of ore. However, Curve IIIa for 0.25 A. T. of ore is substituted for Curve III beyond 60 per cent sulphide mineral content because of the violent action of more than 18 grams of niter in the charge. The percentage of the sulphide minerals in the pulp is estimated by observing the panning of a small amount on a watch glass.

Table of Reducing Powers

Group	Minerals	R.P.	Average R. P.
I	Chalcocite	4.8	
	Galena	3.4	
II	Arsenopyrite	7.0	
	Bornite	7.4	
	Chalcopyrite	8.5	7.6
	Sphalerite	8.3	
	Stibnite	7.0	
III	Pyrite (containing some pyrrhotite)	11.6	11.6

Similar charts may be constructed with one or more curves, depending on the sulphide ores encountered in the laboratory. All relations are straight-line, so that only two points are needed for each curve. Point "O" is the weight of flour necessary to produce the lead button desired; and the upper point is the niter necessary to produce the same desired button with a charge containing 100 per cent sulphide mineral. The scale of the abscissa of the flour portion of the curve is the equivalent of flour in terms of niter. The upper point is calculated by the following formula; where

R. P. = reducing power of sulphide mineral or group,
S = per cent sulphide mineral in sample,
W = weight of pulp sample in grams,
L = weight of lead button desired in grams, and
O. P. = oxidizing power of niter.

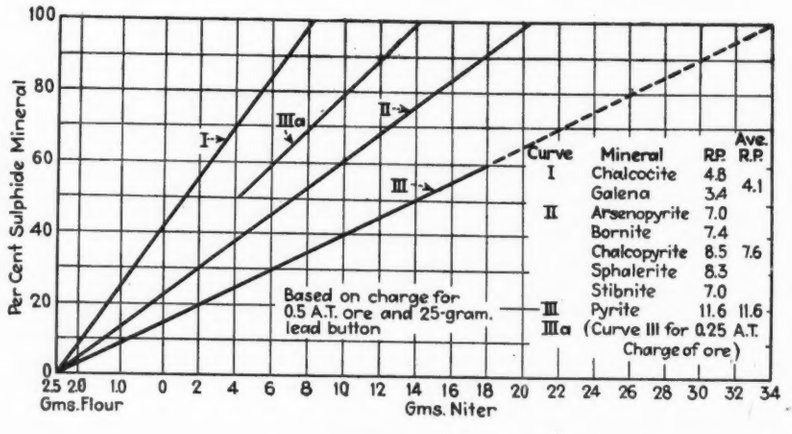
$$\text{Grams niter necessary} = \frac{\left(\text{R.P.} + \frac{\text{S} \times \text{W}}{100}\right) - \text{L.}}{\text{O.P.}}$$

As an example: for Group II minerals with (R. P.) 7.6, (S) 100 per cent sulphide mineral content, (W) 0.5 A. T. (14.58) of ore, (L) 25-gram lead button, and (O. P.) as 4.2 for the oxidizing power of niter, the calculation of the upper end point becomes:

$$\text{Grams niter necessary} = \frac{(7.6 \times 100 \times 14.58) - 25}{\frac{100}{4.2}} = 20.4 \text{ gms.}$$

As an example of the use of the chart: Let it be assumed that an ore composed principally of quartz and pyrite is being assayed. Panning on a watch glass reveals the sulphide mineral content to be approximately 40 per cent; and, as the sulphide is pyrite, Curve III represents the requirements of this ore. The 40 per cent sulphide mineral ordinate intersects the curve at 10.2 grams of niter, which is the niter to be added to the charge to give the desired results.

The use of this chart is an improvement over the calculation method both in time saved and in visualizing the latitude allowed. A judicious use of the curves in combination according to the minerals present has resulted in more successes with the sulphide ore assays.

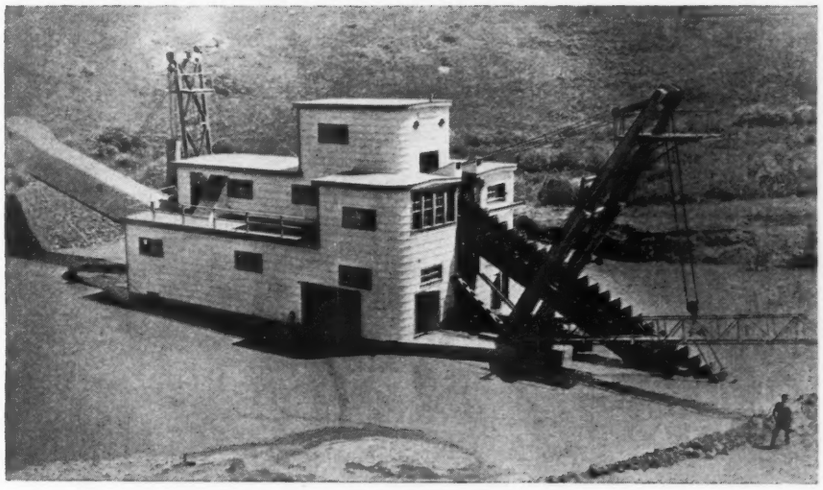


Again the Question of Assessment Work

(*Continued from preceding page*)

to whether it is advisable once again to suspend the legal requirement respecting annual assessment work for another year, lies a related question—namely, to what extent is the annual assessment work, which claim holders make affidavit they have done in accordance with the law, actually performed in those cases or in those years where suspension has not been authorized. In other words, where the law is functioning normally, to what extent is the performance of assessment work "faked" instead of being faithfully performed? Gossip has it that "faking" is all too common, and unfortunately this gossip cannot readily be controverted or, for that matter, proved. In any case, however, Congress might well give the possibility due consideration, in making up its mind, as it will shortly have to do, whether or not to authorize such suspension for another year.

Dredging Washington Bar



THE NEW DREDGE at Washington Bar, Mont. Its hull is built of 23 steel pontoons

A pontoon-type boat with 4.5 cu. ft. buckets is handling 3600 cu. yd. daily for this new enterprise

F. G. Frink, Jr.
Washington Iron Works
Seattle, Wash.

THE PROPERTY of the Gold Creek Mining Company is at Washington Bar, about 70 miles southeast of Butte, Mont., and 9 miles from the terminal of a branch railroad running out of Butte. It is accessible also over a good automobile highway. Washington Bar is well known for its placer workings, some having been worked by hand more than twenty years ago. Elevation is 6,500 ft., and, with the possible exception of a shutdown of a few weeks during extremely cold weather in winter, operations are carried on throughout the year. Water is plentiful and is available at all times. The exploitable placer ground is free of underbrush and trees, fairly sloping, and covers some grazing range.

The Gold Creek company acquired the placer ground soon after having withdrawn from another dredging operation at Gold Creek, Mont. Following an extensive drilling campaign to determine the extent and value of the gold-bearing gravel, a 4½-cu.ft. pontoon-type bucket dredge was decided upon as suitable, and on March 1, 1938, a contract for its manufacture was awarded to the Washington Iron Works, of Seattle, Wash. The dredge was placed in operation on July 6, four months later.

The ground under exploitation requires hard digging. It is cemented and contains many large boulders (some handled through the dredge and out over the stacker belt measured as much as 47 in. in diameter on the larger axis). Digging varies from 20 to 28 ft. against a 10- to 15-ft. bank, which is caved by undermining. Despite the tightness of the ground and the presence of boulders, the digging action of the dredge is fast, and about 3,600 cu.yd. of gravel is handled. This daily output is expected to be increased materially when the dredge moves into higher ground. Proper design and use of special alloy steels in the manufacture of parts for the digging and washing elements are largely responsible for the successful exploitation of ground that otherwise would require a 9-cu.ft. unit of the older type.

Dredge equipment, weighing about 400 tons, was shipped by rail from Seattle to Norris, Mont., whence it was transported by a 5-ton truck with trailer to the dredging site, 9 miles distant. Parts were handled by a 1¼-yd. Northwestern dragline (45-ft. boom), with a 60-hp. Caterpillar tractor doing miscellaneous jobs on the ground. Erection of the dredge was completed within nineteen days after arrival of the pontoons at the dredge pond. Credit for this fast time is due to good organization of the different crews, proper fitting of all material and parts at the shops, and experience of the superintendent in erection work. Fourteen men were employed during this period. The management has provided an excellent camp for the workers.

The hull is built of 23 steel pontoons and measures 90 ft. in length, 39 ft. in width, and 6 ft. 1½ in. in depth, with a resultant freeboard of 20 in. when fully equipped and digging 28 ft. All pontoons are electrically welded and watertight. Bolting connections are jig-drilled to obviate any fitting in the field. Gantry footings, machinery, and beam supports are built into the pontoons. The 4½-cu.ft. buckets are of manganese steel, with renewable manganese lips and eye inserts. Each lip is locked onto the bucket, providing a clean dumping surface on the inside. The cutting edges are so designed as to stay sharp.

The lower tumbler is a two-piece unit of manganese steel operating in special rubber-sealed bearings; the upper tumbler is a one-piece chrome-nickel-molybdenum steel casting with alloy-steel wearing plates. Ladder rollers are manufactured from manganese steel, and all have rubber-sealed bearings. Special double-sealed roller-bearing dredge blocks at the ladder point for the bow swing lines eliminate a troublesome maintenance problem at this point. The digging ladder has an extra section bolted in the center for digging 28 ft. When depths of 20 ft. or less are reached, this section will be taken out.

Equipment has been spaced and balanced so that the deck of the pontoon hull is free of encumbrances, and

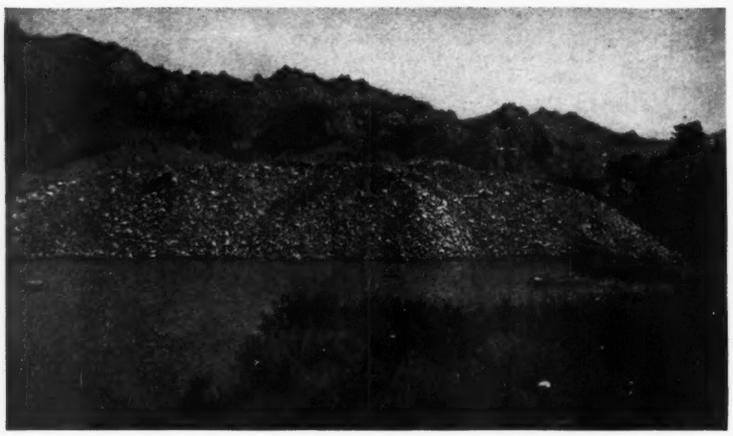
all parts are easily accessible. The winch is a self-contained, seven-drum unit with structural base, and mounted on deck. It is directly geared to the motor mounted on the winch base. The clutches are single-adjustment internal wide-range type, designed for hard service. Bow swing drums can be operated independently of the other.

The revolving screen is 5 ft. in diameter and 33 ft. long, with a screen section measuring 23 ft. It is driven by an electric motor through a reversible V-belt drive. The 85-ft. stacker ladder contains a V-belt driven 30-in. belt made by the American Rubber Company. Idlers are of the Jeffrey Timken roller-bearing type. The stacker is metal-covered and heated. Digging ladder and well way also are heated for sub-zero operation. The gold tables are of all-steel construction and contain side and tail sluices. Hungarian-type riffles made from solid rubber by the American Rubber Company are used. Room has been provided for possible installation of jigs in the future.

All pumps installed on the dredge are direct-driven by motors. The center of the dredge has a depression longitudinally draining to a chute through the stern pontoon. This provides a dry footing at all times and facilitates washing down the deck. The dredge housing is of wood construction and streamlined.

Concentrates are carried to the clean-up room on the top deck, where they are run through a rotary amalgamator and subsequently over a copper amalgamation plate. This obviates the need of any panning during clean-up. A total of 260 hp. is consumed. Electric power is furnished by the Montana Power & Light Company over a 11,000-volt transmission line 7 miles long and built by the owners. The voltage is stepped down to 2,300 at a shore station, whence a submarine cable on floats transmits the power to the dredge proper.

The dredge was designed under the direction of G. H. Hubbard, chief engineer of the Washington Iron Works, from specifications submitted by the dredging company. W. F. Crown erected the dredge at Norris, Mont., with W. Schmidt representing the Gold Creek Mining Company as adviser. Thanks are due to Nathan Schwartz, president of the Gold Creek company, for permission to use the data here presented.



DIGGING ACTION of the new dredge is fast, despite tight ground and boulders, some of which are seen in the upper photograph. The rock in the center is 47 in. on its longer axis. The lower photograph shows tailings piles at Washington Bar

Beneficiating Kyanite and Barite

FOR several years samples of kyanite from most of the important deposits in the United States have been under investigation, state E. S. Leaver and J. A. Woolf in United States Bureau of Mines Progress Report R.I. 3436. Gravity concentration processes are almost invariably deficient in recovery of this bladed mineral, as many of the slivers of kyanite are washed off tables or jigs with minerals of lower specific gravity. Only that portion of the kyanite that has crushed into more blocky grains is recoverable with efficiency. Table agglomeration is better than gravity tabling, but also has not given the results that flotation permits. Both high grade and high extractions are possible, and both anionic and cationic reagents can be used. Studies of the fibrous kyanites, as distinguished from the bladed kyanites, and of the sister minerals, sillimanite and dumortierite, will bring this research to a close, and an extensive report describing the results is to be prepared. The report will include a description of work on the heat-treatment of kyanite. Whereas three years ago flotation concentration of kyanite held little promise, owing to the demand of the consumer for coarser particles, the tide has now turned toward finely ground kyanite. For both bladed and fibrous kyanite and for sillimanite and dumortierite, flotation is well adapted as a concentration process. During 1938 garnet was noted as a mineral that tends to float too often under the same conditions that are suitable for the kyanite.

Two methods for the concentration of Southern barite ores were tried—classification and tabling and froth flotation. The ores investigated were contaminated with one or more of the following impurities: silica, fluorite, iron oxide, and calcite. Classification and tabling are not applicable for the removal of iron oxide from barite, and this method is only fairly effective for the removal of fluorite and calcite. However, on a high-silica ore from South Carolina, classification and tabling proved satisfactory. This ore contained 73.7 per cent barite and 22.0 per cent silica. By classification and tabling, a concentrate was recovered that analyzed 96.0 per cent $BaSO_4$, with 89.6 per cent recovery.

All of the ores under investigation were tested by froth-flotation methods. The ores most difficult to treat by flotation were those containing high percentages of both fluorite and calcite. Although the concentrates from these ores were fairly high grade, the recoveries were low.

Fitchered Holes

An account of some mining failures

A. R. Fletcher
Consulting Engineer
El Paso, Texas

RECENTLY I found myself reflecting on how differently my life has turned out to be from what I thought it was going to be 30 year ago when I was a newly graduated mining engineer. John Hayes Hammond and Pope Yateman were the outstanding engineers of that period, and consequently I imagined my future self lodged in a New York skyscraper, commuting to London, sending cables to Borneo, and organizing exploring expeditions to Thibet. Needless to say, life did not follow that pattern.

I also believed in those early years that mistakes were fatal; that good mining engineers never made them; and I imagined, conversely, that my achievements and successes would be promptly and generously rewarded. Neither has been the case. I have had many failures and they have all been condoned, and I have had a few successes and they have usually been taken as a matter of course. Which man is, after all, the more fortunate? Is it he whose successes are immediately and generously rewarded or he whose failures are forgiven? I am inclined to believe it is the latter man, because an early success generously rewarded may lift the recipient above himself and close the door on much experience, whereas a failure that does not wreck a man leaves his feet firmly planted on the path of wholesome humility and stands sentinel against the repetition of the error it represents throughout his entire after-life.

Failures in mining, particularly in its creative departments, can hit from many angles. Faulty geological imagination has been responsible for many of mine.

The Veta Madre of Guanajuato is an immense vein stretching from the Valenciana mine at its northern end to the Serena mine at the southern extremity. It has produced hundreds of millions of ounces of silver, and the Serena mine itself is credited with a production of more than ninety million ounces. The Serena orebody is cut off by the Amparo fault, and the immediate extension of the Veta Madre to the south of this fault has never been found or at least does not outcrop for a distance of more than half a mile.

One engineer thought he had solved the problem of this disappearance. He believed the Veta Madre was thrown back toward the east by the Amparo fault for a distance of about 1,400 ft. and that it did not outcrop because, covering its dislocated position, there was porphyry flow which, he assumed, had buried it. This engineer had further observed that the ore touching the Amparo fault in the Serena orebody was slickensided and that drag ore from the Serena orebody had been carried for some distance along the Amparo fault. He reasoned from these facts that the fault was younger than the orebody; that the fault had cut the orebody in two and that consequently there was another piece of cake in the cupboard. Having arrived at these conclusions, he interested financially some Englishmen in Manchester, and they invested $25,000 to test his theory with the diamond drill. This drill was installed; 86 ft. of hole was drilled; and then the money gave out. No more money was forthcoming. Things were at a standstill.

When the engineer brought his plight to me, I decided to go to Guanajuato to check his findings, and after studying the matter, I came to the conclusion that he was right and recommended to my company that we finish the drill hole. In the course of time, this was accomplished. The vein was found within a hundred feet of its predicted location and it was, thank Heaven, absolutely barren.

In the case just recorded, the fallacy in my geological reasoning was clearly evident after the fact of failure revealed it. The Amparo fault already existed before the Serena ore was deposited. It obligingly acted as a boundary during the orebody's period of gestation and let no ore get past the imperviousness of its plastic gouge. After the orebody was formed, the fault became restless and moved again, thus increasing its total displacement. That movement was the one that had scored the ore resting next the moving fault with slickensides and carried pieces of it into the fault plane itself. In other words both pre- and post-mineral movement had occurred in the fault plane and not merely post-mineral movement.

All this happened a long time ago. I had not seen so many big faults in the Cordillera as I have since. After a great deal of experience, I can generalize and say that I have never in the Cordillera seen a fault of large displacement truncate an orebody. Instead, such faults usually stop them quite effectually. For one thing, there is too much mud in such faults. This stops ore as surely as too much mud on a road stalls an automobile. These venerable pre-mineral faults are not the daddies of ore; they are the bachelor uncles and maiden aunts. They were already there and full of gouge when the ore was being born in the parent veins adjacent to them.

During the depth of the depression, I had time on my hands, and to relieve the tedium of unoccupied days I made a study of and later took a lease on a little mine south of Gage, in New Mexico. I reasoned that if a crosscut were driven sticking to a dolomite horizon, it would ultimately reach the intersection of a vertical fracture and an inclined fault in that horizon. A similar conjunction of circumstances had housed the biggest orebody in the mine.

I chose a point in the wall of an old stope to start my crosscut so that I could dispose of the muck without tramming it, and started to drive the 90 ft. to my destination. That is, I started as soon as I could find someone who was not perfectly content languidly to ornament a shovel five hours a day for WPA at 45c. an hour on the Deming streets. Those men demanded $16 a foot for a 7x5 ft. drift. A skillful hand driller could have made wages at $7 a foot. I finally paid $9. Anyway, I drove the 90 ft. and found neither fracture nor fault. After the preliminary expenses, paying workmen's compensation insurance, and organizing a company to avert personal damage suits, I was out about $3,000. A joke on me was that after the muck from my crosscut began to fill the little stope into which it was being dumped, my men, in poking around, found another parallel crosscut about 25 ft. away from mine. Before the growing muck pile created a new angle of vision, the entrance to this crosscut had been hidden by a shadow thrown by a projection in the wall of the stope, and for that reason I had missed seeing it. Someone about 50 years ago had anticipated my idea. We were both wrong but we both tried.

The mine is leased today and is producing about 300 tons a month of ore and diluent. The man who is leasing it is making probably $250 a month.

I shall not go into why my theory failed to work in this case, but I didn't get fired. The Deming Mining & Milling Company could not very well fire its president and chief stockholder.

I have just finished sinking a 72-meter winze looking for an intersection which I thought might produce a new ore horizon in a mine I helped bring into existence about ten years ago and

hated to see die. The intersection was not there. Another failure and a rather poignant disappointment.

What is the lesson to be drawn from these two failures? To the limestone man, it is probably obvious. An endeavor was made in both instances to project structure too far. In limestone, I believe, it is unsafe to project a structure more than 30 ft., which means that a man hunting for ore in limestone must fight his own battle, inspect his faces after every round, and continually alter his campaign to accommodate it to the varying facets of the structure. Occasional authoritative visits by geologists to such mines cannot be very useful and may prove disastrous. All the geologists can do is to elucidate the general controls that have governed the known orebodies and indicate in a general way the locations where similar conditions may exist. The structural mosaic in limestone is complicated and the variations it presents to advancing work are unexpected. Fighting for ore in limestone needs good sergeants rather than absentee staff officers.

I remarked a while ago that failure can hit from various angles. A mine in Jalisco had been looked at so often that the sample channels along the drifts were as closely spaced as railroad ties. It was generally admitted that there were about 20,000 tons of ore blocked out. I figured that 80,000 more could be added by driving a lower tunnel, which would have to be about 1,000 ft. long. The mine had much to recommend it. The ore floated well and had a lot of lead in it, which would give a smelting as well as a mining profit. A high-tension power line crossed the property, and it was only three miles from a railroad station. Should the hundred thousand tons of ore be found, there would be more than half a million dollars of net mining profit at the current metal prices. That was the rub. What would the current metal prices be when the ore was being milled and realized upon? To determine this point, the best-informed authorities were consulted and agreed that the world was confronted by a lead shortage that would endure for a number of years and that £30 sterling was a safe price to assume for lead for several years to come.

The option on the mine was for three years, with no payments, and the tunnel was started in a leisurely way with hand steel, so that it was three years before the development was completed. We found the hundred thousand tons. The grade was about as estimated, but things had been happening to the lead market. It had hit the long toboggan slide that ended in a price of £7 sterling a ton. By the time we had to decide whether or not to take up the option, the half million dollar profit I had calculated had been wiped out. When metal prices finally hit bottom, the ore would have shown a $2 per ton operating loss. Needless to say, the option was not exercised. The loss in driving the 1,000-ft. tunnel was considerable and it was my fault.

It will be seen that the cause of this failure was purely economic. An engineer's judgment is peculiarly vulnerable when exposed to economic change. As a rule the larger a mining project is, the smaller is its profit margin. Large mines are likely to be low-grade mines. In the old days, the future was somewhat predictible and the average of metal prices during a period of immediately prior years could be predicated as a future probability. Today with paper currencies, imminent national insolvencies all over the world, fiat metal prices and tariff barriers, wars and rumors of wars, no one can predict the future. In making my own decisions, I cling to the present and ask myself just one question: If the mine were in production today would it be making a lot of money? If the answer is an emphatic "Yes," I shut my eyes as the devout do in prayer, and repeat "Eeny, meeny, miney, mo." Then if the answer to this augury is still "Yes," I have arrived at my decision and recommend the project.

The Case of the Cigarrera

An offer of $4,000,000 was once made and refused for the Cigarrera mine. Today the mine is abandoned and has been dismantled. Its chief orebody was discovered by following downward an insignificant leady iron stringer which occurred at one tip of a large iron outcrop. After following this for about 60 ft. the orebody was cut and followed downward for a thousand feet of prosperity. Then it was lost, but how is hard to determine, because the bottom of the workings is full of waste. Diamond drilling was then resorted to and another orebody found at a distance of about 250 ft. horizontally from the bottom of the one that had been exhausted. This orebody proved to be a large chimney and was mined vertically downward for about 200 ft. to water level. As this chimney continued downward from about the same level as that at which the upper orebody ceases, geologists have made two assumptions. One is that the lower orebody is the faulted continuation of the upper. The other theory is even more ingenious but less convincing.

Impressed by the fact that the outcrop was extremely large and that the root reaching down to the upper orebody was insignificant, it occurred to me that an undiscovered upper continuation of the lower orebody might exist and that it might have reached, through an independent and hitherto unknown channel, the large outcrop of iron on the surface, thus accounting for that outcrop's disproportionately large size. At the Reforma mine, five orebodies join just before reaching a common exit. The outcrop at Cigarrera seemed altogether too big to be accounted for by the one orebody that was known to have used it as an exit. I believed two orebodies had used it just as you and I sitting in different seats in a theater and using different aisles go out by the same door when the show is over. Following this idea, I made terms for the mine and put a few men to work on the outcrop with hand steel. They worked for more than a year, and the more work they did, the larger the outcrop proved, and the more work there was to do. It gradually became apparent that I had far underrated the outcrop's size and the consequent difficulties of adequately exploring it. To have continued at the slow pace I was going would have protracted the time necessary to explore the outcrop thoroughly to ten years. This was not feasible. The alternative was a more rapid exploration by machine and diamond drill, which of course meant more men and an investment in equipment. But that was not all it meant. It implied a heavy preliminary expense that would have nothing to do with footage. A social ambient would have to be created for those men to live in. Housing, water, sewage disposal, a school and a hospital—all these would have to be provided in advance so as to fit the nascent enterprise to the social ideology of the country: It hardly seemed to me that the wager was worth such elaborate preparation, and so I accepted defeat. After all, the next generation will want the thrill of finding some new orebodies.

This failure represents a type that will become more common in the years ahead of us. Finding a new mine or finding new ore in an old mine is an adventure, and adventure has always entailed hardships. Laws or systems of society that ignore the inevitable association of adventure with hardship and prohibit the practice of the economies of hardship while one is adventuring, will not create Utopias at the end of our rainbows but will banish the rainbows from our skies.

I have been moved to make this confession of some of my failures because one gains the impression from a perusal of technical literature that all mining problems are successfully solved and that all mining ventures succeed. I have been associated with some really big failures, but only as an orderly attached to the general staff. The ones I have told of here were defeats where I commanded the skirmish and was personally vanquished with no one to blame but myself. To me, a mining career is a battle, whereas mining literature somewhat erroneously but, I believe, unconsciously, tends to reflect it as a smug triumphal progress.

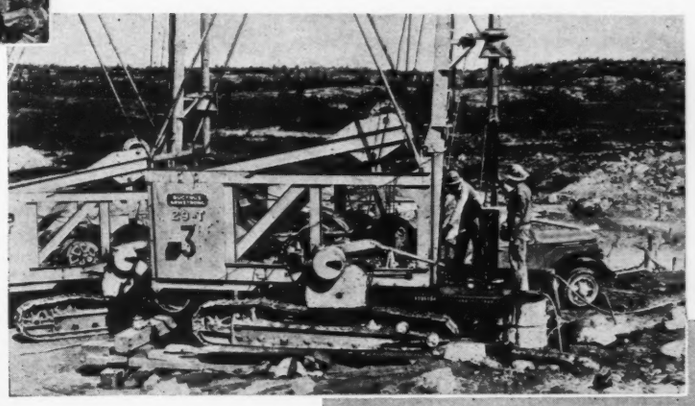
One of the two new electric shovels serving the Frood pit is loading a 21-cu-yd. (35-ton) truck. These shovels have a 4½-cu.yd. dipper, a 32-ft. boom, and weigh 165 tons each. They are equipped with Ward Leonard control. Incidentally and appropriately, each has over 16 tons of nickel-alloy steel

A fleet of the 21-cu.yd. Mack trucks that serve the shovels. Each weighs 57 tons loaded and has 10 forward speeds and 2 reverse. The wheel base is 160.56 in. and the triple axles are of chromium-nickel steel. Power is supplied by a 1500-hp. Cummins diesel engine. In the rear is the Frood shaft

An Open Pit for the Frood Mine

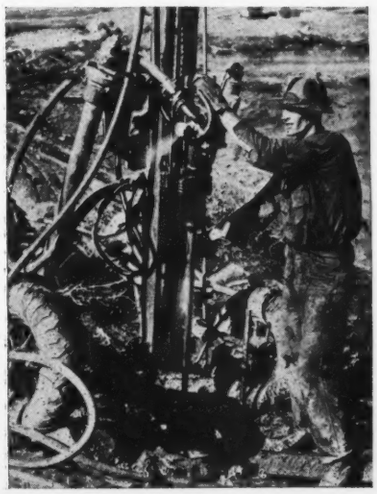
OPERATIONS to recover the lower-grade material that occurs in the top portion of the Frood orebody in the Sudbury district in Ontario were started by the International Nickel Company of Canada late in 1938. This ore will be recovered by open-pit mining over an area that is approximately 4,000 ft. long and 400 ft. wide. At the outset the outcrop is being leveled to the elevation of the general surface surrounding it with the aid of electric shovels and trucks, the ground being broken by blast holes put down with churn drills and wagon drills. The sides of the open pit are to be carried at a 1-to-1 slope for safety and to permit the construction of roads for truck transport into and out of the cut. By combining the lower-grade ore that will thus be won in the surface working with the richer material mined at depth, a satisfactory average grade of ore, it is said, will be assured over the future life of the mine. The accompanying photographs have been supplied through the courtesy of International Nickel.

One of 35-ton trucks dumping



A churn drill, one of four, putting down a 9-in. hole at the Frood pit. It is operated by a 20-hp. variable-speed electric motor. The string of tools weighs 3,000 lb., including the 600-lb. bit. Drilling rate is 56-58 strokes per minute and the travel of the tools 44 in.

Drilling is also done with four wagon-type air drills like this. Each makes 40 to 60 ft. of hole per 8-hour shift in waste, using a 3-in. starter. Maximum depth of hole is 26 ft.



Preparing to blast. The churn-drill holes are deck-loaded, granulated powder in bags being used with explosive fuse. An average blast breaks about 12,000 tons. The wagon-drill holes are sprung and loaded with stick powder

Open-Pit Transport
On the Mesabi Range

V

The Differential and Woodford Haulage Systems in Comparison

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THOUGH the analyses in previous articles showed a saving of 6.58c. per ton of concentrate to be made by replacing steam haulage with electric haulage using standard 65-ton locomotives hauling four 30-cu.yd. cars, other types of electric haulage are also now being used that should be considered. These types are as follows:

1. A train with electric locomotive carrying ore load and pulling three 30-cu.yd. trailer cars.

2. A lorry train of two or more motorized cars with all weight on the drivers and control cab on first car, as built by Differential Car Company.

3. Several individual motorized cars operated with remote control by one operator from control station on pit bank. This is commonly known as the Woodford haulage system.

Type 1 involves the use of a train similar to the trains previously discussed, with the advantage of replacing the dead load of the locomotive with live ore load, reducing the dead weight of the train and increasing the 6.58c. saving by perhaps another half-cent. As Types 2 and 3 incorporate not only all the advantages of Type 1 but allow the cars to operate on grades up to 10 per cent, we can save discussion by considering them only.

The Differential Train—In iron-ore pit operation, if the haulage equipment can operate economically on grades up to 10 per cent, the first big saving can be secured by revamping the track layout in the pit. In the pit under discussion a study showed that for less than $12,000 cuts and fills could be made and a new track laid branching from the old track at point "L" on the surface (Fig. 4). The new track has a 10-deg. curve all the way into the pit, with a 9 per cent grade all the way to the bottom of the orebody at 460-ft. elevation. By using this new track other savings are possible. First, all the ore in the track benches on the south side of the pit can be released, which means that no tonnage need be left for expensive clean-up when the pit is exhausted. Second, by being able to get into the pit without switchbacks, spring switches, or electric switches, it may be possible to operate a motorized three-car train without a brakeman, resulting in a saving of another $7,000 or in a reduction in costs of another cent per ton.

Table XIII—Weights of Motorized Train and Load

	Dead Weight, Lb.	Load, Lb.	Loaded Weight, Lb.
Control car	42,000	85,000	127,000
Two motorized trailers	78,000	176,000	254,000
Total ...	120,000	261,000	371,000

Summary and comparison of haulage costs for the standard electric locomotives and the motorized train have been made in Table XIV. These figures show a saving, using this new type of car, of more than 1.3¢. per ton of concentrates. They also show a reduction in the length of haulage track of two miles, which will be increased to three miles when the bottom of the ore in the pit is reached. This type of train has been developed since the new high-strength alloy steels appeared on the market, and the reduction in weight of these units shows a material saving compared to the old-style cars still in use.

Reference to Table III on train weights (Part II, page 53, *E.&M.J.* November, 1938) shows that the total weight of an electric train of the type previously considered carrying 220 tons is 447 tons, or the ratio of ore load to trainload is approximately 1:2. The loaded weight of the new

Table XIV—Summary and Comparison of Haulage Costs in Open-Pit Mine
Electric Lorry Car Train vs. Electric Locomotive Operation

Summary—Electric Lorry Operation—Three Trains		Summary—Electric Locomotive Operation—Four Trains	
Capital Investment		**Capital Investment**	
3 3-car trains at $55,000	$165,000	4 65-ton electric locomotives	$130,000
10-mile distribution system at $5,000/mile	50,000	16 30-cu.yd. dump cars at $4,500	72,000
10-mile track system at $12,000/mile	120,000	12-mile distribution system at $5,000/mile	60,000
1 sub-station—750-kw. capacity	42,000	12-mile track system at $12,000/mile	144,000
		1 sub-station—750-kw. capacity	42,000
Total	$377,000	Total	$448,000
Capital Decrease, $71,000			
Operating Expense		**Operating Expense**	
Electric power for pit, shovel, and washing plant $47,227		Electric power for pit, shovel, and washing plant $47,227	
Electric power haulage 9,300		Electric power haulage 13,360	
Total electric power	56,527	Total electric power	60,587
Train maintenance	3,445	Locomotive maintenance	3,445
Crew: wages, engineers	8,316	Crew: Wages, engineers	11,088
wages, brakemen	5,250	Wages, brakemen	7,000
Lubricants	50	Lubricants	50
Electric maintenance	8,620	Electric maintenance	8,620
Total	$82,208	Total	$90,790
Fixed charges at 13%	49,010	Fixed charges at 13%	58,240
Total operation and fixed charges	$131,218	Total operation and fixed charges	$149,030

Saving with lorry car trains, $17,812 per year.

train, as shown with one control car and two motorized trailers, is 185 tons, with the train weighing only 60 tons and carrying 116 long tons of ore, which changes the ratio just cited from 1:2 to 1:1.6. This is shown in Table XIII.

Although this train carries only 116 long tons, compared to 220 tons borne by the other, its ability to climb heavy grades at fair speeds without loading the power lines too heavily reveals such a time cycle that the capacity of three trains is ample to care for a production of 700,000 tons of concentrate per year, compared with four standard electric locomotive trains that would be required.

The train time cycle, figured for the average shovel location of 583-ft. elevation, is given in the following:

	Minutes
Loading time, at 11 long tons per minute	10.5
500 ft. level track in pit at 10 m.p.h.	0.57
1,440 ft. 9 per cent grade at 10 m.p.h.	1.64
14,445 ft. from pit to washer at 20 m.p.h.	8.23
Return trip empty, 16,385 ft. at 25 m.p.h.	7.45
Dumping time	1.50
Minimum time required for dumping cycle	29.9

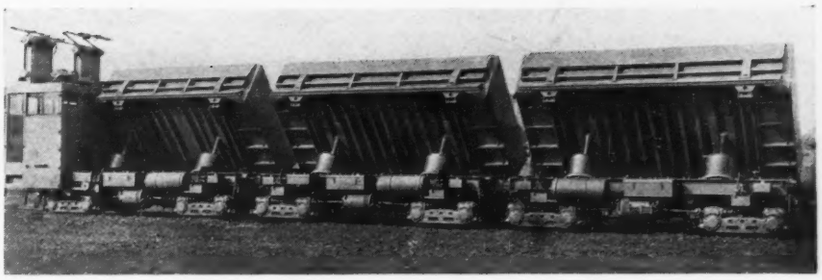
With three trains, each having a payload of 116 tons and based on an 8-hr. shift of 4,375 tons, 38.2 minutes would be available for each complete train cycle. Based on a maximum 5,000-ton shift, 33.5 minutes would be available for each train shift. Therefore, the waiting time in each cycle would be as follows:

On the 583-ft. level, with 4,375 tons per shift, 38.2 minutes minus 29.9 minutes equals 8.3 minutes.

On the 583 ft. level, with 5,000 tons per shift, 33.5 minutes minus 29.9 minutes equals 3.6 minutes.

For the 460 ft. level, which is the ultimate bottom of the pit, there is to be added 1,433 ft. of 9 per cent grade. This increases the cycle as follows:

Ascending 1,433 ft. on 9 per cent grade at 10 m.p.h. adds 1.62 minutes.



A DIFFERENTIAL TRAIN on surface at a Lake Superior Iron Country property, with the car bodies in dumping position. Note that the locomotive carries an ore load

Descending this grade at 20 m.p.h. adds 0.81 minutes. This increases the total train cycle to 32.3 minutes. Therefore, on the 460-ft. level the waiting time in each train cycle, based on a 4,375-ton shift, is 5.9 minutes (38.2 minus 32.3). Based on a 5,000-ton shift it is 1.2 minutes (33.5 minus 32.3).

Current Consumption—A low current consumption per ton may be expected with the Differential train on two counts: The ratio of payload to dead weight is much higher, as mentioned in the foregoing. Second, the operation on steep grades also cuts down the power consumption per ton. It is estimated the current consumption per ton measured on the d.c. bus is 0.6 kw.-hr. per long ton. This figure includes 5 kw.-hr. per round trip for the air compressor, 3 kw.-hr., or 5 per cent, for down-hill running, spotting, and miscellaneous items, and 8 per cent for line loss.

The 5 kw.-hr. estimated for the air compressor is comparable to the 10 kw.-hr. included in the estimate for the standard electric locomotive, inasmuch as the difference in train weight for braking and the amount of air required for dumping the trains would be approximately half that required in the case of the Differential train.

Another worthwhile advantage derived from the use of this type of three-car train is realized when carrying out the stripping program. If any area adjacent to the pit is being stripped above the ore, the collecting locomotives can haul the trailer loads from the shovel to the point "L," where they can be coupled on to the three-car train and hauled to the dump close to the washing plant. This combination could save the use of one locomotive by utilizing the three-car motorized train on the long haul with a light grade. An installation of the Differential train was described in *E.&M.J.*, Nov. 23, 1931, page 446.

Saving With Lorry Operation—A saving of $17,812 per year with electric lorry operation, using three (Differential) trains, is possible, as compared with standard electric locomotive operation, using four trains. The summary and comparison of haulage costs is given in Table XIV.

Motorized Cars With Remote Control—This system would use ten 20-cu.yd. double-truck drop-door cars operating between the shovels in the pit and the washing plant on the same track layout as used in the Type 2 haulage system (Differential train). The main control tower will be placed at the entrance of the pit and the sub-control tower at the washing plant. The entire operation will be conducted by two operators—one in each tower. The washing plant operator will also dump the cars in addition

Table XV—Summary and Comparison of Haulage Costs in Open-Pit Mine

Cars Operated by Remote Control vs. Electric Locomotive Operation

Summary—Cars Operated by Remote Control		
Capital Investment		
Remote control equipment		$150,000
10 20-cu.yd. motorized cars at $4,000		40,000
1 400 kw. M.G. set at pit control tower		10,000
1 250 kw. M.G. set at washing plant		9,000
Supplies for installation		13,000
Labor		5,000
10-mile track at $12,000		120,000
10-mile distribution system at $5,000		50,000
Total		$397,000
Operating Expense		
Electric power for pit, shovel, and washing plant	$47,227	
Electric power haulage	9,300	
Total electric power		56,527
Car maintenance		3,445
Crew wages: Engineer at control station		2,772
Man at washing plant		1,750
Lubricants		50
Electric maintenance		8,620
Total		$73,164
Fixed charges at 13%		51,610
Total		$124,774

Summary—Electric Locomotive Operation—Four Trains		
Capital Investment		
4 65-ton electric locomotives		$130,000
16 30-cu.yd. cars at $4,500		72,000
12-mile distribution system		60,000
12-mile haulage track at $12,000		144,000
1 sub-station—750-kw. capacity		42,000
Total		$448,000
Operating Expense		
Electric power for pit, shovel, and washing plant	$47,227	
Electric power haulage	13,360	
Total electric power		60,587
Locomotive maintenance		3,445
Crew wages: Engineers		11,088
Brakemen		7,000
Lubricants		50
Electric maintenance: shovels, locomotives, washing plant (including 5-mile overhead contact wire)		8,620
Total		$90,790
Fixed charges at 13%		58,240
Total		$149,030

Saving remote control system per year: $24,256.

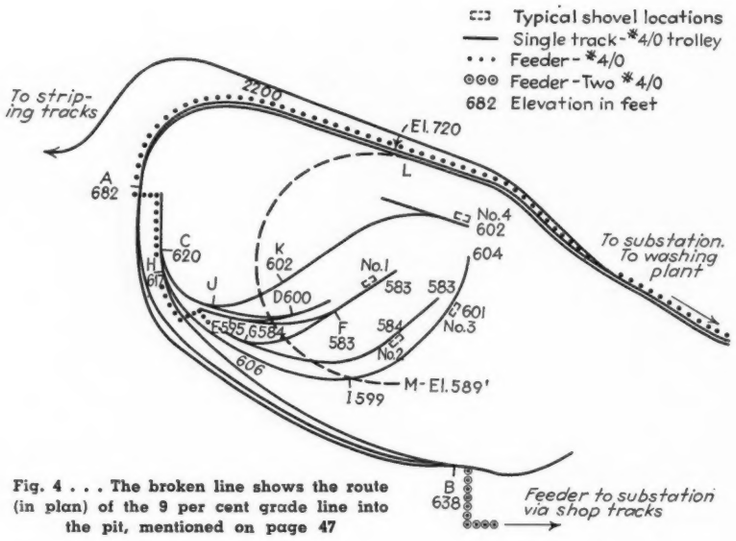


Fig. 4 . . . The broken line shows the route (in plan) of the 9 per cent grade line into the pit, mentioned on page 47

to receiving and dispatching them.

There will be a 400-kw. motor-generator set in the main tower at the edge of the pit, this being the point of central distribution. An auxiliary set of 250-kw. capacity will be located at the washing plant. The operator in the main control tower will manipulate all of the empty cars entering the pit and distribute them to the shovels through track switches operated from the tower. He will also manipulate the loads leaving the pit and for part of the way on their trip to the washing plant. This tower contains all the necessary controllers, contactors, and other equipment necessary for complete operation of the cars in any manner necessary to meet any haulage conditions that may arise. The control tower at the washing plant will contain sufficient controlling and automatic apparatus for the operation of the cars between the washing plant and the point on the main track where the main control tower ceases to control them.

Except in an emergency, the cars will operate along the double track between the two towers automatically, with little or no attention from the operators. The operators, however, will be able to take control of any and all of them, either loaded or empty, upon any part of the trip.

Starting, each individual car at different intervals of time cuts down the power peak required. On comparing this with the starting of a three-car train, the additional weight of the single cars will be found to neutralize any large saving in current cost, which explains why the same amount of power for electric haulage is used in each of the two tables of haulage costs. Table XV presents the summary of costs for this system in comparison with the summary of costs when using four 65-ton electric locomotives. Table XIV presents the same comparison of the remote control system with Differential equipment.

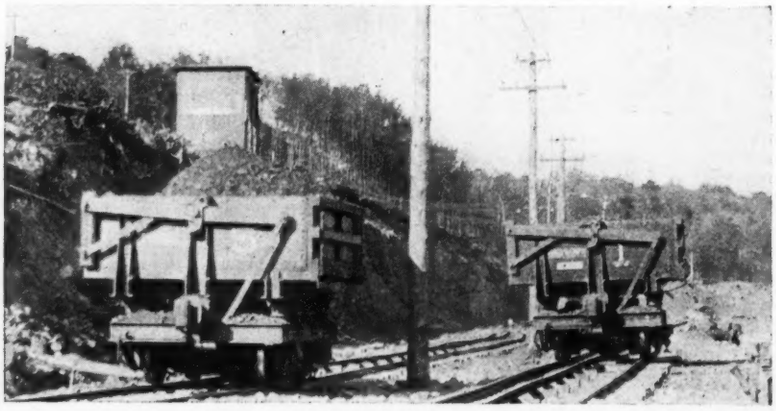
Saving With Remote Control—The cost of haulage using cars operated by remote control compared with haulage using standard electric locomotives is given in Table XV. A saving of $24,256 is shown in favor of remote control.

One reason why operators in the past have not given the remote control system the consideration it may have deserved is to be found in the fact that at times, either during the night or during heavy fogs that occur at certain seasons of the year, it is difficult to see points in the pit from the control tower. This fault has been overcome by an adequate signal system, making it unnecessary for the operator in the tower to see the cars upon any section of the haulage system, except in the immediate vicinity of the shovel and washing plant.

The most recent installation of this system is that made last year in a rock quarry at Leeds, Ala., by the Universal Atlas Cement Company. Most of the trackage is on a 9 per cent grade, up which the loaded 10-cu.yd. cars run at 7 m.p.h. The Michigan Alkali Company, of Alpena, Mich., has used this system in its limestone quarries since 1916 with satisfactory results, proving that this type of haulage has been thoroughly tested and is past the experimental stage. An installation of the Woodford haulage system on the Marquette range was described in *E.&M.J.*, Dec. 14, 1931, pages 486 and 487.

(*To be continued*)

REMOTE CONTROL of single cars is the essential feature of the Woodford haulage system, here seen in use in an Iron Country open pit



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Turkish Chromite Studied

DR. F. MEYER, writing in the last issue of "M.T.A.," the official publication of the Institute for Mineral Investigation and Research, at Ankara, Turkey, says that 175 chrome ores of Turkish origin have been analyzed in the Institute's laboratory in the last two and a half years. In most cases only the chromium, iron, and silica have been determined. The silica content varies with the fluctuating amount of serpentine or hornblende, being between 1 and possibly 6 per cent for the most part. Whereas in pure chromite there is 32.2 per cent FeO and 67.8 per cent Cr_2O_3, giving a FeO-Cr_2O_3 ratio of 0.47, in almost 90 per cent of the Turkish ores examined the ratio ranged from 0.27 to 0.35. In 57 of the 175 cases the ratio ranged between approximately 0.27 and 0.29; in approximately 80 of the ores, between 0.30 and 0.35; and in the remainder approximately half showed a ratio greater than 0.35 and half a ratio smaller than 0.26. The theoretically necessary value of 0.47 was shown by only one of the ores. The FeO content was 13-16 per cent in 70 per cent of the cases, averaging 14.5 per cent. That of Cr_2O_3 was 46-52 per cent, averaging 49 per cent. Densities, as determined by Dr. Schröder, of the Mineralogical Section of the Institute, varied from 4 to 4.2, that of pure chromite being 4.93.

Power for Ahmeek Mill

Cost per kilowatt-hour placed at 0.35 cent

A. L. Burgan
Mill Superintendent
Calumet & Hecla Consolidated Copper Company
Hubbell, Mich.

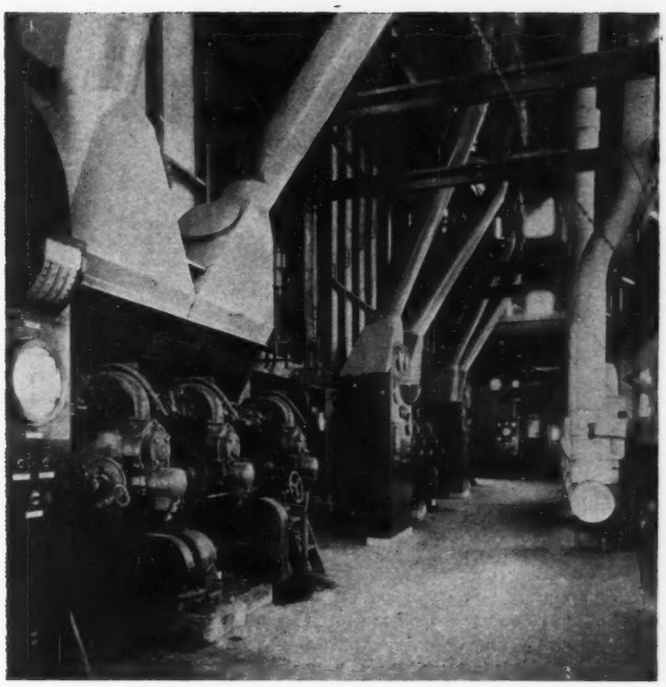


Fig. 1 . . . In the boiler house. This view of the operating floor shows the stokers, main steam piping, and the control panels

THE boiler house at Calumet & Hecla's Ahmeek mill, in the Michigan copper country, was built in 1930-31 to replace the hand-fired plant which had furnished 80,000 lb. of steam per hour at 170 lb. pressure, and also to supply 85,000 lb. per hour of steam for a new turbo-generator of 7,500-kw. capacity, this generator to operate in parallel with six other generators totaling 24,300 kw. One of these six is a 2,000-kw. back-pressure turbine using 70,000 lb. of Ahmeek mill process steam at 16 lb. absolute. The other five generators are at the other plants of the Calumet & Hecla company.

Both boiler house and the 7,500-kw. turbine room are in separate buildings. These are of steel frame covered with galvanized corrugated iron laid over 2-in. matched wood sheathing with paper between. Steel sash with hinged windows and roof ventilators furnish light and ventilation. The roofs are of precast gypsum supported on steel framing and covered with four-ply composition roofing. The inside walls are finished with cement plaster on metal lath. Concrete piling supports all columns of buildings and conveyor as well as the foundations for turbines, boilers and stack. The turbine building is equipped with a traveling crane designed for a 30-ton normal load and a 47½-ton occasional load. The heat required in this building is provided by unit heaters, the condensate being returned by pumping to the turbine condensate pipe line.

Coal handling—The existing coal bins which served the old boiler plant are utilized. They are incorporated in the concrete structure which supports the mill rock bins about 55 ft. above the ground. Coal is delivered in 22-ton cars over the company railroad and dumped from the rock service track through hoppers and chutes into the bins. From these the coal runs by gravity to a 24-in. apron conveyor traveling east 12 f.p.m., which delivers the coal to a 26x24-in. belt-driven two-roll crusher. The crusher drops the coal in sizes 1½ in. and smaller to a troughing belt conveyor traveling south. This belt is 170 ft. between centers, 20 in. wide, and inclined at an angle of 18 deg. It in turn delivers the coal to another similar conveyor, which is 213 ft. between centers, and travels west over the suspended bunkers in the boiler house and distributes the coal by means of a tank type tripper.

Boilers—The boiler-house equipment is designed with three boilers, two of which can furnish the 165,000 lb. normally required plus the necessary steam for auxiliaries. Auxiliaries common to all three boilers are in the west end of the boiler house and are large enough to serve a fourth boiler. The east end of the building is constructed to provide possible extension for a fourth boiler should the future make it desirable.

The three boilers are 8,955-sq.ft. Stirling four-drum units, built for 450-lb. pressure. Each is provided with superheater, soot blowers, a 5,800-sq.ft. economizer and a stoker. The stokers are of the single-ended seven-retort, 38-tuyère, underfeed type with a double-roll clinker grinder and coal hopper agitator. They are driven by individual steam turbines using steam at boiler pressure and exhausting at about 5-lb. pressure. They have hand and automatic speed regulators. Each boiler has a turbine-driven forced-draft fan and a motor-driven exhaust fan, which may be operated at either of two speeds, being coupled to two motors, one at either end, with speeds of 710 and 460 r.p.m., respectively. The forced-draft fan has a capacity of 40,000 c.f.m. against a static pressure of 9 in. of water. Capacity of the exhaust fan against the same head is 70,000 c.f.m. at 710 r.p.m. and 35,000 c.f.m. at 460 r.p.m. The exhaust fans deliver to the stack, which is of reinforced concrete, of 12 ft. inside diameter and 175 ft. high.

Three 450-g.p.m., four-stage, centrifugal boiler-feed pumps direct connected to steam turbines and with duplicate water lines to economizers are provided, one pump having sufficient capacity to serve all three boilers at the normal load of 180,000 lb. of steam per hour. Fig. 1 gives a view of the main steam piping, stokers and control panels. Figs. 2 and 3 show the forced-draft fans and feed pumps. Fig. 4 is a cross-section of the boiler house which gives the general layout.

Combustion control—By means of combustion-control equipment, the boiler uptake draft and the quantities of air and fuel supplied to the furnace are adjusted to suit the load on the boilers. As the load varies, the pressure in the main steam header changes slightly, actuating a master controller which changes the settings of the three induced-draft controllers, one for each boiler. These in turn adjust the uptake draft dampers and the setting of the stoker turbine speed govern-

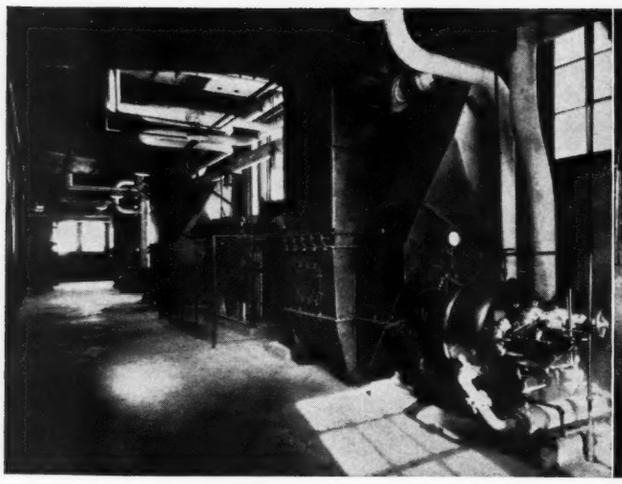


Fig. 2 . . . **FORCED-DRAFT FANS** in the boiler house, with the steam turbine drives

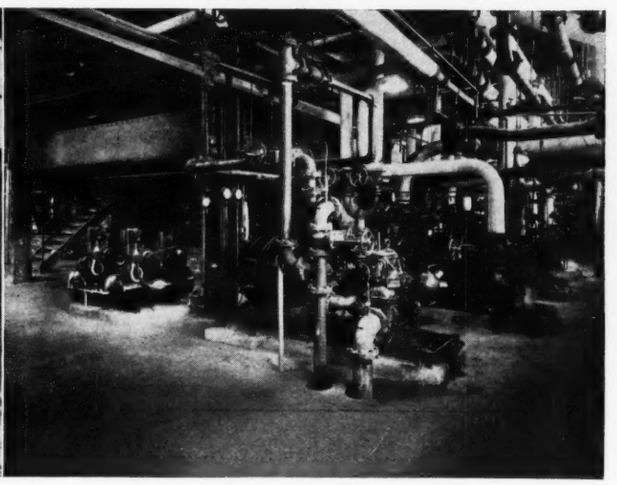


Fig. 3 . . . **CONTROL COMPRESSORS**, the ash pump, and the boiler feed pump

ors. Furnace pressure controllers actuated by the master controllers operate to hold constant furnace pressure by adjusting the forced-draft dampers. This maintains main header pressure within 5 lb. above or below normal. Compensating relays permit of adjusting the relative load on the different boilers at the will of the operator or of holding any boiler at a fixed load while the other boilers take the load changes.

Ash handling—Airtight ash hoppers, 12 ft. by 5 ft. by 8 ft. deep, are built directly under the clinker grinders and reach to the boiler-house floor, which is at surface grade. Hand-operated water nozzles direct streams of water which sluice the ash through doors at the floor level into the hydraulic system. The hydraulic system consists of 560 ft. of 8-in. hard white-cast-iron pipe and fittings, laid under the boiler-house floor in front of the ash hoppers and continued in a concrete trough just below surface grade to the mill-slime tailings pump. The sluicing nozzles located at proper points along the line of 8-in. pipe are supplied by a 600 g.p.m. motor-driven pump at 160-lb. pressure. Fifteen tons of ash per hour can be handled.

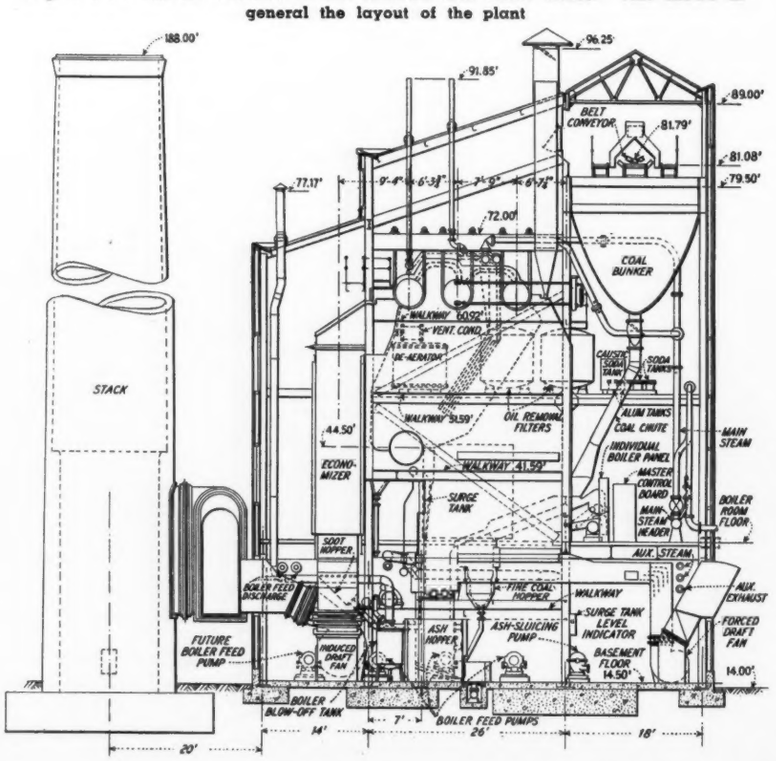
Feed water—Under normal conditions the boiler feed water is made up of approximately 52 per cent condensate from the 7,500-kw. unit, 42 per cent from the 2,000-kw. exhaust steam unit, and 6 per cent Lake Superior make-up water.

Water is pumped from Lake Superior for boiler feed and domestic purposes. To protect against lengthy interruption of this service, occasionally of 24 hours' duration, a reservoir is provided at a convenient elevation a few hundred feet from the boiler house. It has a capacity of 350,000 gal., sufficient to take care of make-up for 96 hours. A float valve on the inlet keeps the reservoir full.

The make-up water enters the condenser of the 7,500-kw. turbine and is pumped with the condensate and passes through a closed heater after being joined by the condensate from the 2,000-kw. turbine. The closed heater is supplied with steam at 2 to 3 lb. absolute from an extraction nozzle of the 7,500-kw. turbine. This feed water, now at a temperature of 125 deg. F., passes through a de-aerator vent condenser and a vertical, cylindrical, de-aerating heater in the boiler house. The steam for the de-aerating heater consists of the exhaust from the turbine driving the boiler-feed pumps, forced-draft fans, and stokers. The water leaving this equipment at 220 deg. flows to a surge tank and then to the boiler feed pumps, from which it passes through the economizers, entering the boilers at a temperature of 330 deg.

A 10,000-gal. surge tank is provided with an upper valve which controls the flow of make-up water entering the condenser of the 7,500-kw. unit by admitting just the amount necessary to maintain the surge-tank water level below the overflow point. A second float valve about 4 ft. lower than the first provides for the control of make-up water direct to the de-aerating heater when the 7,500-kw. turbine is idle, or if for any other reason that source of feed water fails. In this case the condensate from the 2,000-kw. turbine also is passed to the de-

Fig. 4 . . . **CROSS SECTION** of the Ahmeek mill boiler house. This shows in general the layout of the plant



aerating heater instead of entering the feed-water system ahead of the closed heater in the turbine room.

Feed-water treatment — Steam for the 2,000-kw. turbine being the exhaust from the stamps, the condensate from this turbine contains lubricating oil. This condensate represents 42 per cent of the total feed water. Two pressure-type sand filters with coagulant and alkali-feeding equipment are used to remove this oil before it joins the rest of the boiler-feed water.

To provide for the desired limitation of the boiler-water concentration, a continuous blow-down pipe leading to a flash tank is placed in the middle upper drum of each boiler. The major part of the heat in the water so blown down is reclaimed by the steam flashing to the de-aerating heater.

The Hall Laboratories system is to control the chemical composition of the boiler water and to prevent the precipitation of dissolved solids in a form which would cause adherent scale on the boiler surfaces. Phosphate, which is fed direct to the boilers, by combining with the scale-forming elements in the feed water, forms finely divided insoluble phosphates, which remain in suspension and are removed by blow-down. As this phosphate reduces alkalinity, caustic soda is added to maintain the proper basic condition of the boiler water to protect against corrosion, foaming, and caustic embrittlement. Sodium sulphate, which is fed into the surge tank, tends toward the same result. These measures, together with the de-aerating heater, assure protection against impure water.

Instruments—Recording and indicating meters are used to furnish information for efficient operation of boilers and turbines as well as to determine the proper distribution of steam and power costs.

Counters on the stoker retort driveshaft, when calibrated in service over a period of months, permit of determining coal-consumption rate for any boiler. This, together with steam flow integrating meters for each boiler as well as for total plant load, makes it possible to follow daily the plant or individual boiler efficiency.

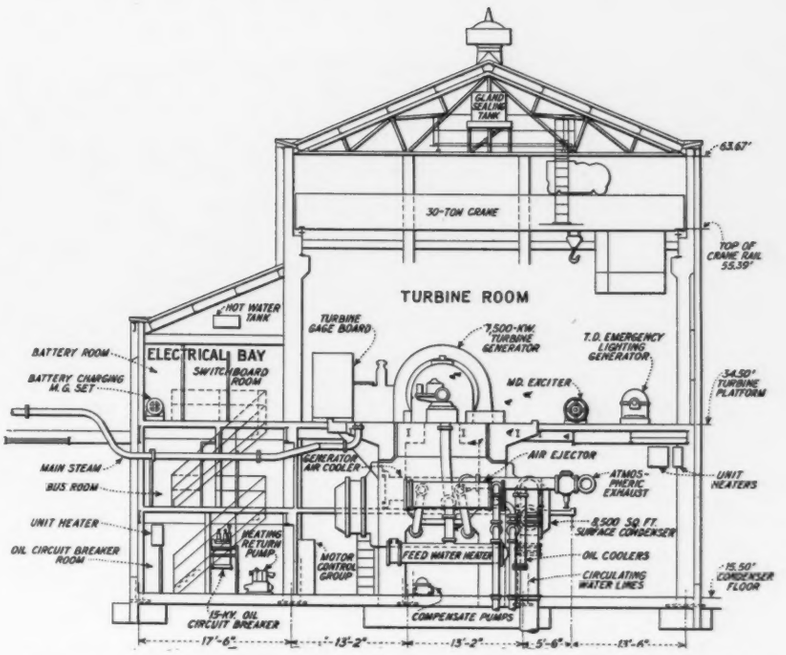


Fig. 5 . . . STEAM TURBINE plant in cross-section, showing arrangement of turbines, auxiliaries, and switchboard

7,500-kw. turbine — The 7,500 kw. unit operates at 1,500 r.p.m. and takes steam at 425-lb. pressure and 650-deg. temperature. Three extraction nozzles are provided for heating the condensate and make-up water for boiler feed.

Condensing equipment consists of an Ingersoll-Rand suspended two-pass, single-compartment surface condenser, with a two-stage steam-jet ejector. A horizontal double-suction motor-driven pump located in the mill pump house furnishes 11,000 g.p.m. of circulating water required by the condenser. The 30,000 g.p.m. required by the Ahmeek mill is pumped from a well which is fed at its south end by gravity from Torch Lake. The 11,000-g.p.m. circulating pump takes its water from the south or inlet end of this well, and when the mill pumps are running, the circulating water discharge from the condenser returns to the north end of the well below water, to eliminate the static head on the pump. The excess water required by the mill pumps over the amount taken by the circulating pump assures condensing water of lake temperature. When the mill pumps are not operating, the circulating water from the condenser is bypassed to Torch Lake.

Fig. 6 shows the turbine with its auxiliaries and switchboard, and Fig. 5 is a cross-section of the plant

Fig. 6 . . STEAM TURBINE generator, No. 8, with its 13,600-volt switchboard. This 7,500-kw. unit takes steam at 425 lb., 650 deg. F.

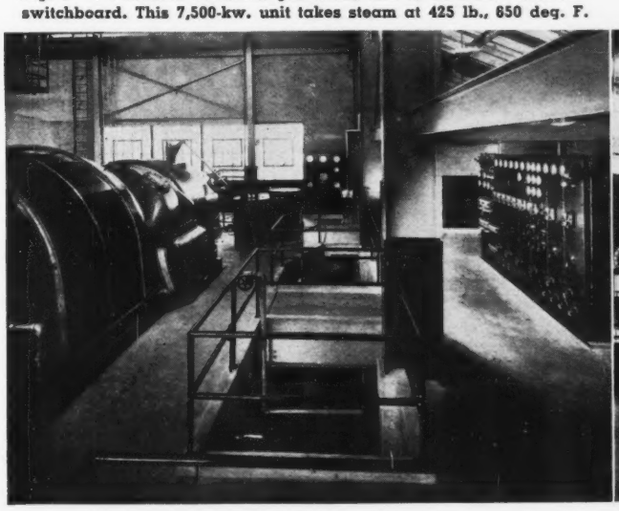
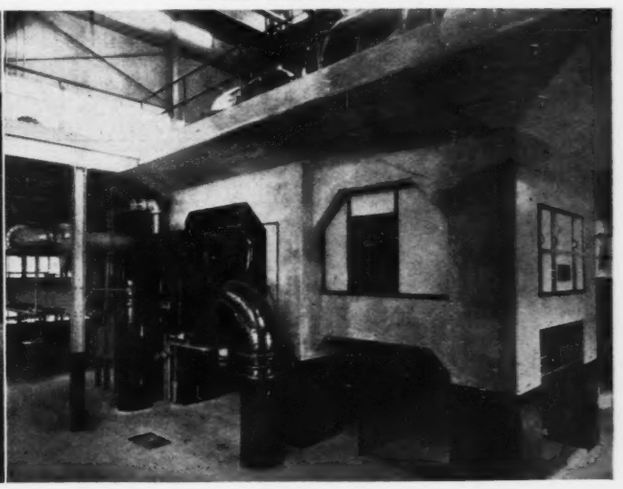


Fig. 7 . . . FOUNDATION of reinforced concrete of No. 8 steam turbine and the condenser



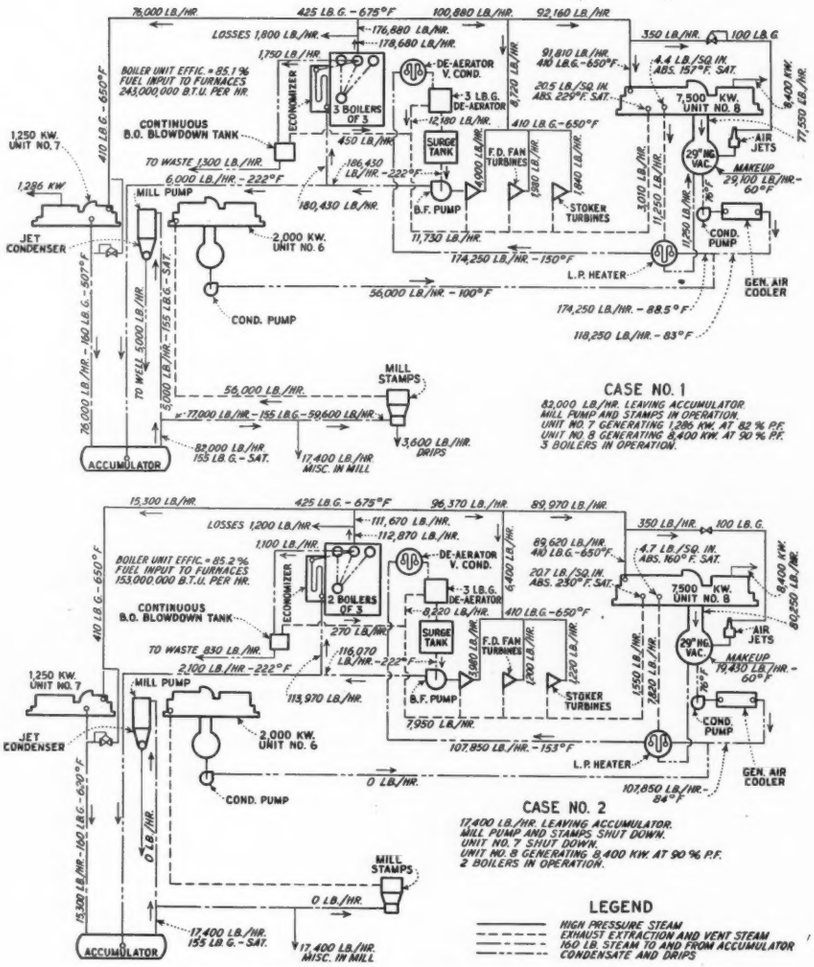

CASE NO. 1
82,000 LB./HR. LEAVING ACCUMULATOR.
MILL PUMP AND STAMPS IN OPERATION.
UNIT NO. 7 GENERATING 1,286 KW. AT 82 % P.F.
UNIT NO. 8 GENERATING 8,400 KW. AT 90 % P.F.
3 BOILERS IN OPERATION.
CASE NO. 2
17,400 LB./HR. LEAVING ACCUMULATOR.
MILL PUMP AND STAMPS SHUT DOWN.
UNIT NO. 7 SHUT DOWN.
UNIT NO. 8 GENERATING 8,400 KW. AT 90 % P.F.
2 BOILERS IN OPERATION.
LEGEND
HIGH PRESSURE STEAM
EXHAUST EXTRACTION AND VENT STEAM
160 LB. STEAM TO AND FROM ACCUMULATOR
CONDENSATE AND DRIPS

Fig. 8 . . . HEAT BALANCE for two different sets of conditions as to load

showing the general arrangement of turbines, auxiliaries and switchboard.

1,250-kw. Turbo-generator—Ahmeek mill requires 80,000 lb. per hour of dry saturated steam. A 1,250-kw. back-pressure unit is used to reduce the boiler pressure of 425 lb. to 165 lb. The turbine running at 4,500 r.p.m. operates the generator at 750 r.p.m. through reduction gears. Exhaust steam from this turbine carries about 140 deg. of superheat. When the mill is shut down or, if, for any other reason, the 1,250-kw. turbine is not running, the necessary steam for the mill is shut down or if, for any are provided; one 4-in. with hand control, and one 4-in. and one 2-in. with regulators set to hold a constant pressure slightly under the back pressure of the turbine. When the mill steam is taken through the bypasses, its superheat is 250 deg. as compared with 140 deg. in the turbine exhaust.

As the mill machinery is not adapted to the use of superheated steam, it is necessary to use a desuperheater to give dry saturated steam for mill purposes. This is of the accumulator type, 8 ft. in diameter by 30 ft. long. It requires for desuperheating approximately 6,500 lb. of water per hour when the turbine furnishes the steam and about 12,000 lb. per hour when the steam is taken through the bypass system. About 3,000 lb. per hour of the de-superheating water returns by gravity to the accumulator as condensates from stamp steam re-heaters and main steam lines.

Fig. 9 shows the turbine together with the bypass equipment. It also shows the exhaust steam turbine and 2,300-volt switchboard as well as the Nordberg 28,000-g.p.m. mill pump. Fig. 8 gives the heat balance with two different sets of conditions as to mill and electrical load, and Fig. 10 is the heat-flow diagram under full load.

The 1937 cost per kilowatt-hour was 0.35¢. This is with coal at $4.39 per ton delivered to boiler house and makes the cost of steam per 1,000 lb. 28.3¢.

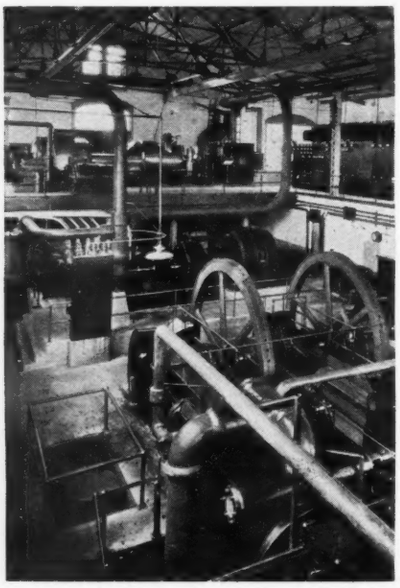
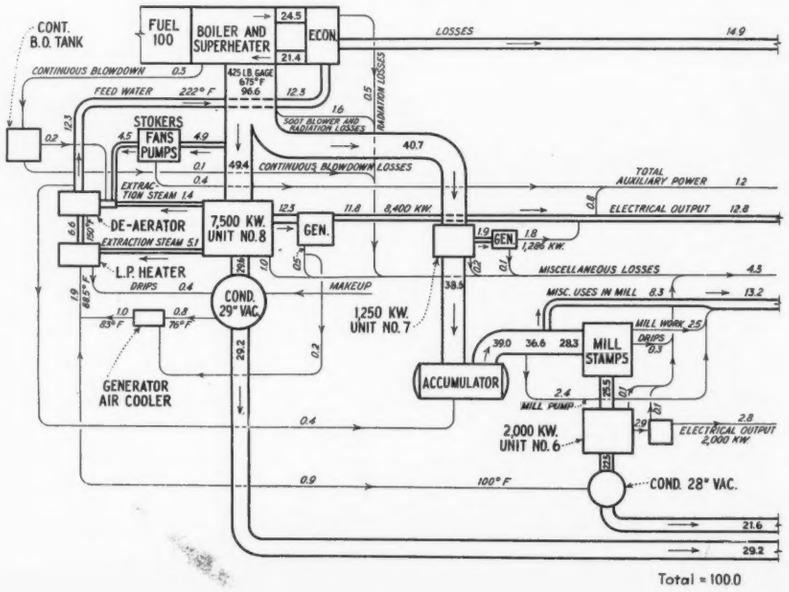


Fig. 9 . . . MILL PUMP and turbine room. Equipment includes the 28,000-g.p.m. triple-expansion reciprocating pump (foreground), the No. 7, 1,250-kw. turbine unit and bypass reducing valves, and (rear) the No. 6 2,000-kw. exhaust steam turbine unit and 2,300-volt switchboard

Fig. 10 . . . HEAT FLOW diagram of plant, when under full load

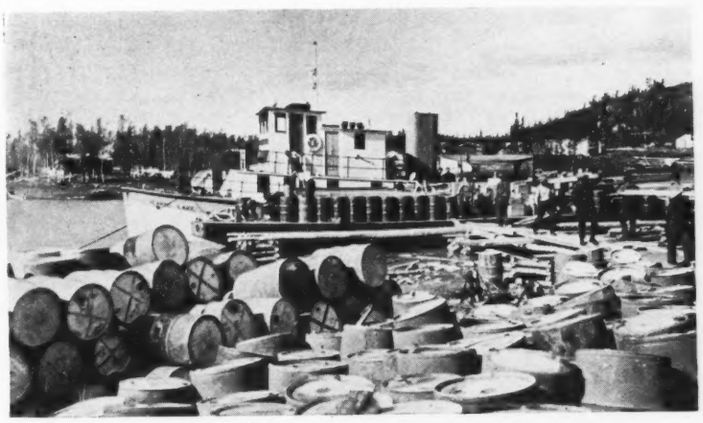


At Yellowknife

THE Yellowknife district, in the Northwest Territories, in Canada, has been an important center of interest in the search for gold in the Dominion in the past year. Numerous parties were active during the prospecting season of 1938, this resulting in many new discoveries, despite which large areas with possibilities remain to be investigated, the district being extensive. In both exploration and development work the Consolidated Mining & Smelting Company of Canada was the leader, its Con property, on which a 100-ton cyanide plant was completed during the season, also being the first to yield gold bullion. The accompanying photographs of the vicinity of Yellowknife were taken by E. Miles Flynn.

Panning on Chan Yellowknife ground. The gold in most, if not all, veins in the district is free, making it possible to detect even low values thus

Town of Yellowknife, in Northwest Territories, as it appeared in July, 1938. Building construction continued up to the season's end



Docks at Yellowknife early in the summer of 1938, since when they have been improved by the Dominion Government

Shaft house on Con property of Consolidated Mining & Smelting Company

On Yellowknife Bay, a safe harbor. These planes commonly carry a 75- to 100-lb. canoe as shown, being equipped with a rubber-covered steel cable for fastening it

On the Dome claims on Pensive Lake, in the Yellowknife district

USEFUL OPERATING IDEAS

Locomotive Haulage Capacity As Affected by Wheel Slip

W. E. Sinclair
Munnik Myburg Asbestos, Ltd.
Kaapshe Hoop, Eastern Transvaal,
South Africa

POPULARITY of the electric storage-battery locomotive is shown by its general use in mines in every part of the world, mainly because of its independence of any power line or trailing cables. This type of locomotive gives flexible service in main-line haulage or on branch-line work, and in fact can be used to gather trucks in any part of the mine where tracks of suitable gage are in existence.

This point raises the question of the efficient haulage capacity on badly laid tracks, sharp curves, and maximum grades—conditions which are invariably found in any other than main haulageways. A calculated drawbar pull based on a coefficient of adhesion of from 20 to 25 per cent (depending on whether wheels are of chilled cast iron or steel) may be found to work on a well-laid and evenly graded haulage, but on badly laid tracks with varying grades and curves, frictional resistance is reduced to much less than the 20 lb. per ton usually allowed for each per cent of grade.

Because of these conditions, the estimated 60 per cent locomotive efficiency based on a calculated drawbar pull to give a certain haulage capacity of a certain maximum load falls to the ground and the battery is overtaxed. No allowance is made for the decreased capacity of the battery when discharging at a high rate, and apart from lowered haulage capacity of the locomotive, more time is required for charging batteries.

The main trouble is simply lack of frictional resistance due to wheel slip. The weight of the locomotive is a factor in calculating its haulage capacity chiefly to help overcome this trouble. In addition, tractive resistance in starting or in hauling over difficult grades can be increased by feeding sand on to the rails and by so doing decrease drawbar pull and increase haulage speed.

The type of locomotives here under consideration are not usually fitted with sand boxes or any necessary mechanical device for feeding sand on the track wherever this is required. Also, a special quality of sand would be essential, so that only small quantities need be used to do the work.

These troubles assumed rather serious proportions in the Munnik Myburg asbestos mine at Kaapsche Hoop, Eastern Transvaal, South Africa, where the bad track conditions were aggravated by an accumulation of a greasy mixture of slush along the tracks and rails resulting from the ground-up wet fines from the soft talcose serpentine rock formation and the asbestos fiber. The effect of this slippery mixture on the tracks was a varying factor, but it was a continuous handicap on steep grades. Reduced capacity on the worst of these sections was responsible for measuring the whole haulage capacity of the locomotive, because it was limited to only half a train of empties against the grade.

The solution of the difficulties seems simple now that it has been found that by nicking the surface of one rail along the bad sections of the track, tractive resistance is so much increased that wheel slip is almost entirely eliminated. The nicks are cut across the rail at about one-inch intervals by means of a blacksmith's cold set, which is held at a slight angle to the rail, to cause the cut to face downgrade. When the nicks on one rail become worn down, the opposite rail is treated in the same way.

The additional frictional resistance has made no noticeable difference on the loaded train coming out down grade.

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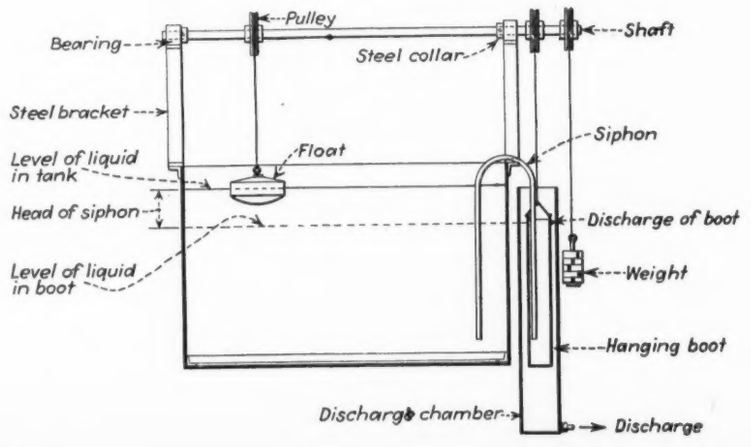
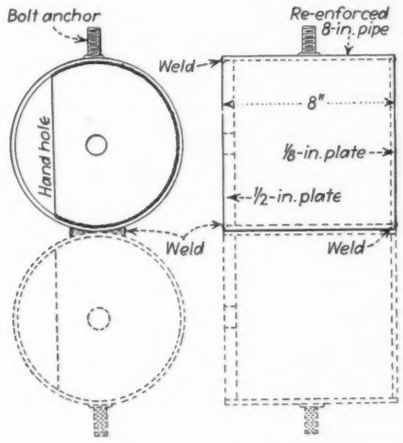
Simple Constant-Flow Device

AT CYANIDE MILLS and chemical plants there is often need for a dependable device to give a constant flow of chemicals or reagents to different plant units. Where skilled labor is plentiful, automatic factory-made devices may be used to advantage, but in remote mining regions where plants are tended mostly by unskilled workers, the problem must be solved by simpler means. A device that has given good results in such a locality—a Mexican cyanide mill—is illustrated in the accompanying sketch. It essentially consists of a short transmission shaft with three small pulleys mounted above the supply tank; a boot with a discharge near the top, operating in the discharge chamber proper; a siphon, a float, and a counterweight. The float, boot, and weight are suspended from their respective pulleys by means of thin steel cables. The siphon is set



Steel Guide Pocket for Concrete Shaft

THE PRACTICAL and relatively inexpensive guide pocket or fastener illustrated in the accompanying sketch has given satisfactory service in the Denn shaft of the Shattuck Denn Mining Corporation at Bisbee, Ariz. It is both safe and easily aligned during concreting operations. As will be seen, each unit is made of old 8-in. extra-heavy steel pipe, of which there was a large amount on hand, cut into 8-in. lengths by an acetylene torch. The front end contains a welded-on semicircular plate of ½-in. iron, leaving an opening for inserting a wrench or the hand,



while an ⅛-in. plate on the back end prevents the entrance of concrete. Anchorage is provided by a protruding bolt.

During concreting operations, the guide pockets were held in place with a metal wedge that fitted into the opening of the pipe. This wedge extended out through the semicircular notch in the wooden shaft form, and another wedge driven into the hole held the pocket firmly in place. A bolt was then inserted through the guide pocket and both the forms at the curtain wall, and then bolted tightly. This held the guide pocket rigid. At the junction of two shaft guides welded twin guide pockets were used.

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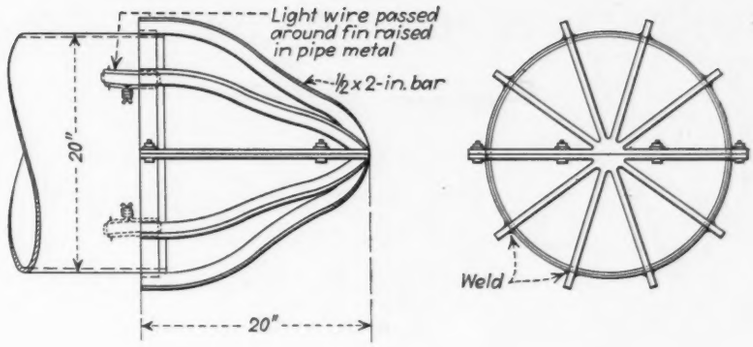
with one leg in the liquid of the supply tank and the other in the hanging boot.

Operation of the device is simple: The head of the siphon, and therefore its flow, are controlled by lowering or raising the hanging boot. Once set, the head and discharge remain constant, for the float and boot rise and fall with the liquid of the supply tank. All parts were made from scrap.



Protective Tip for Ventilating Pipes

AN INNOVATION at the 11-mile Stanislaus tunnel now being driven in Central California by the Pacific Gas & Electric Company is the use of a steel tip, or frame, for protecting the end of ventilating pipes from damage by rock fragments thrown from the face during blasting. Protected by this device, 20-in. ventilating pipes are run to within 40 ft. of face and are left in place during blasting without danger of harm from flying rock fragments.

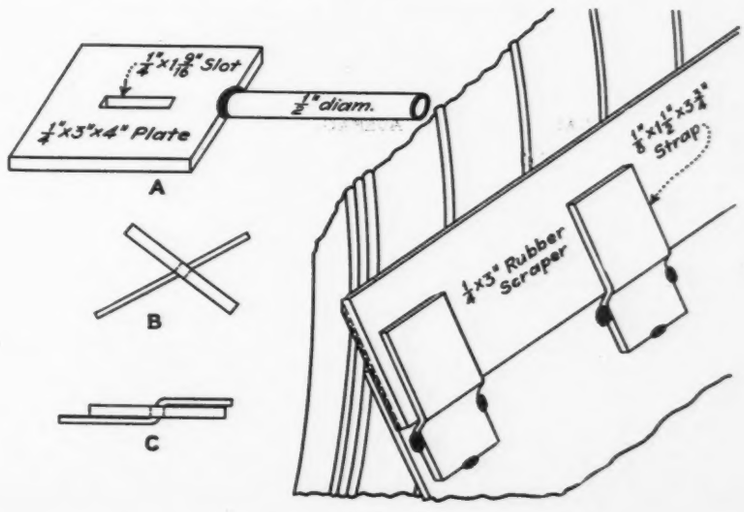
The tip consists of two halves each made up of five straps of ½x2-in. bars welded together in the manner as shown in the accompanying sketch. The halves are bolted together and the assembly is then slipped over the end of the pipe and held in place by a pair of light wires passed around fins raised in the pipe metal for this purpose. Harry F. Scott is tunnel superintendent.

▼ ▼ ▼

Rubber Scraper for Drum Filters

THE MERITS of a rubber-scraping device for drum filters are obvious to the mill operator. Even with regular dressing, a metal or wooden scraper will wear filter covers and fail to follow a slightly uneven drum, according to V. T. Berner, Mojave, Calif.

A sufficient number of ⅛ x 1½ x 3¾-in. metal clips, for spacing at 8-in. intervals across the width of the blade, are first made up to provide seizure for the ¼ x 3-in. rubber strip. The form (A) may be used to advantage in bending the clips. Simply insert the 3¾-in. strap 1½ in. into the slot (B) and flatten with one blow of a broad-faced hammer (C). Then, with the rubber strip projecting 1½ in. over the old steel scraper, the clips are spot-welded on 8-in. centers. A ¼-in. two-ply, rubber launder-lining material (Grade 1165 Armorite or something similar), cut by the manufacturer into 3-in. strips, will serve well. As the fabric side of the material is placed downward, it is well to grind off the sharp edge which contacts the drum. Subsequent replacements of the scraper are made by merely pulling out the worn rubber and pushing the new one down into the clips. If the rubber strip is not continuous, clips should be placed at all ends.



Summary of the

MARKETS

DEMAND for lead improved appreciably during February, but the call for copper, zinc, and tin remained quiet. Though general business activity slackened somewhat last month, the movement of non-ferrous metals into consumption did not suffer greatly, and, with inventories reduced, was probably sufficient in volume to have stimulated buying under normal conditions. Nervousness continued because of the unsettlement in London quotations. The constant threat of imports in those items that do not enjoy heavy tariff protection naturally upset traders.

Reflecting lower monthly averages for lead and tin, the *E.&M.J.* index of non-ferrous metal prices for February declined to 76.89. In January the index stood at 77.12 and in February of last year it was 73.43.

Domestic producers of copper maintained their quotation at 11¼c., Connecticut Valley, but with London appreciably under that level, consumers refused to extend their rate of buying sufficiently to strengthen the price structure here. Metal involving Commodity Exchange warrants was available at concessions, which also confused consumers. Production has been reduced in this country and the foreign group announced that output, beginning March 1, will be set at 95 per cent of basic tonnages, a reduction in the operating rate of 5 per cent. The curtailed output, plus a seasonal upturn in consumption, is expected to stabilize prices all around. Domestic sales for February amounted to 19,844 tons.

In the last two weeks of February the sales of lead to domestic consumers amounted to fully 20,000 tons. The price was dropped on Feb. 16 to 4.75c., New York, owing to weakness abroad. During January 1,735 tons of slab zinc were imported, 1,018 tons from Mexico, 610 tons from Canada, and the remainder from Poland and Belgium. Prime Western zinc held at 4½c., St. Louis. Foreign quicksilver was marked up to stimulate buying and the domestic price responded by advancing $8 per flask.

UNITED STATES MARKET

1939	Electrolytic Copper		Straits Tin	Lead		Zinc
Feb.	Domestic (a) Refinery	Export (b) Refinery	New York	New York	St. Louis	St. Louis
1	11.025	9.925	46.375	4.85	4.70	4.50
2	11.025	9.875	46.100	4.85	4.70	4.50
3	11.025	9.850	45.950	4.85	4.70	4.50
4	11.025	9.875	45.950	4.85	4.70	4.50
6	11.025	9.900	46.000	4.85	4.70	4.50
7	11.025	9.925	45.750	4.85	4.70	4.50
8	11.025	9.825	45.650	4.85	4.70	4.50
9	11.025	9.825	45.650	4.85	4.70	4.50
10	11.025	9.750	45.550	4.85	4.70	4.50
11	11.025	9.750	45.500	4.85	4.70	4.50
13	Holiday	9.750	Holiday	Holiday	Holiday	Holiday
14	11.025	9.700	45.350	4.85	4.70	4.50
15	11.025	9.625	45.000	4.85	4.70	4.50
16	11.025	9.600	45.100	4.75	4.60	4.50
17	11.025	9.575	45.400	4.75	4.60	4.50
18	11.025	9.675	45.500	4.75	4.60	4.50
20	11.025	9.675	45.400	4.75	4.60	4.50
21	11.025	9.650	45.400	4.75	4.60	4.50
22	Holiday	9.675	Holiday	Holiday	Holiday	Holiday
23	11.025	9.625	45.450	4.75	4.60	4.50
24	11.025	9.600	45.600	4.75	4.60	4.50
25	11.025	9.625	45.700	4.75	4.60	4.50
27	11.025	9.650	45.700	4.75	4.60	4.50
28	11.025	9.725	46.000	4.75	4.60	4.50
			AVERAGES FOR MONTH			
	11.025	9.735	45.640	4.805	4.655	4.500
Feb.			**AVERAGES FOR WEEK**			
1	11.025	9.792	45.954	4.783	4.633	4.500
8	11.025	9.875	45.900	4.850	4.700	4.500
15	11.025	9.733	45.410	4.850	4.700	4.500
22	11.025	9.642	45.360	4.750	4.600	4.500
Feb.			**CALENDAR WEEK AVERAGES**			
4	11.025	9.854	46.121	4.833	4.683	4.500
11	11.025	9.829	45.683	4.850	4.700	4.500
18	11.025	9.654	45.270	4.790	4.640	4.500
25	11.025	9.642	45.510	4.750	4.600	4.500

SILVER, GOLD, AND STERLING EXCHANGE

NEW YORK AND LONDON

1939	Sterling Exchange		Silver		Gold	
Feb.	"Checks"	"90-day demand"	(c) New York	London	London	(d) United States
1	4.677500	4.662500	42.750	19.9375	148s 7½d	$35.00
2	4.677500	4.662500	42.750	19.9375	148s 7½d	35.00
3	4.677500	4.663750	42.750	20.0000	148s 7½d	35.00
4	4.677500	4.665000	(e)	20.0625	148s 7d	35.00
6	4.682500	4.670000	42.750	20.0625	148s 5½d	35.00
7	4.686250	4.674375	42.750	20.1250	148s 4d	35.00
8	4.683750	4.670625	42.750	20.1250	148s 4d	35.00
9	4.686875	4.673750	42.750	20.2500	148s 3½d	35.00
10	4.685625	4.672500	42.750	20.1875	148s 3½d	35.00
11	4.684375	4.671250	(e)	20.3750	148s 5d	35.00
13	Holiday	Holiday	Holiday	20.4375	148s 4½d	Holiday
14	4.686250	4.673125	42.750	20.3750	148s 3½d	35.00
15	4.685000	4.671875	42.750	20.4375	148s 4d	35.00
16	4.683125	4.670000	42.750	20.6250	148s 4½d	35.00
17	4.685000	4.670625	42.750	20.7500	148s 4½d	35.00
18	4.686875	4.671875	(e)	20.6875	148s 3½d	35.00
20	4.685000	4.670000	42.750	20.7500	148s 5d	35.00
21	4.685000	4.670000	42.750	20.6875	148s 4½d	35.00
22	Holiday	Holiday	Holiday	20.6250	148s 4d	Holiday
23	4.687500	4.672500	42.750	20.5625	148s 4d	35.00
24	4.690000	4.676875	42.750	20.5000	148s 3½d	35.00
25	4.691875	4.679375	(e)	20.4375	148s 2½d	35.00
27	4.691250	4.678750	42.750	20.3750	148s 2d	35.00
28	4.687500	4.674375	42.750	20.5625	148s 3d	35.00
Average for Mo.	4.68472	.....	42.750	20.370	.....	35.00
			AVERAGES FOR WEEK			
Feb.						
1	4.67510	.....	42.750	.....	.....	.....
8	4.68083	.....	42.750	.....	.....	.....
15	4.68563	.....	42.750	.....	.....	.....
22	4.68500	.....	42.750	.....	.....	.....

Calendar week averages: New York Silver, 4th, 42.750; 11th, 42.750; 18th, 42.750; 25th, 42.750.

(e) Not quoted (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.325c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order effective Jan. 1, 1939, the U. S. Government's price on newly mined domestic silver was continued at 64.64c. Handy & Harman's quotation for domestic silver, 999 fine, was 64⅛c. per ounce throughout February.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1939 Feb.	COPPER Standard Spot	COPPER Standard 3 months	COPPER Electro Bid	TIN Standard Spot	TIN Standard 3 months	LEAD Spot Buyers	LEAD Spot Sellers	LEAD 3 months Buyers	LEAD 3 months Sellers	ZINC Spot Buyers	ZINC Spot Sellers	ZINC 3 months Buyers	ZINC 3 months Sellers
1.....	42.8125	43.1250	48.2500	216.0000	214.7500	14.4375	14.5000	14.6875	14.7500	13.6250	13.6875	13.9375	14.0000
2.....	42.8750	43.1250	48.0000	215.2500	214.2500	14.2500	14.3125	14.5000	14.5625	13.5625	13.6250	13.8125	13.8750
3.....	42.8125	43.1250	48.5000	215.1250	214.0000	14.3125	14.3750	14.5000	14.5625	13.5000	13.5625	13.7500	13.8125
6.....	43.1875	43.4375	48.2500	215.3750	214.8750	14.3125	14.3750	14.5000	14.5625	13.6250	13.6875	13.8750	13.9375
7.....	43.0625	43.3750	48.2500	215.5000	214.2500	14.3750	14.4375	14.5625	14.6250	13.5625	13.6250	13.8125	13.8750
8.....	42.5000	42.8125	47.5000	213.7500	212.5000	14.2500	14.3125	14.4375	14.5000	13.3750	13.4375	13.6875	13.7500
9.....	42.8125	43.1250	48.2500	215.0000	213.7500	14.2500	14.3750	14.5000	14.5625	13.5000	13.6250	13.8125	13.8750
10.....	42.1875	42.5625	47.2500	214.5000	213.0000	14.2500	14.3125	14.4375	14.5000	13.5000	13.6250	13.8125	13.8750
13.....	42.3125	42.6250	47.2500	214.0000	213.0000	14.2500	14.3125	14.3750	14.4375	13.5625	13.6250	13.8125	13.8750
14.....	42.1250	42.4375	47.5000	214.0000	212.7500	14.1875	14.2500	14.3125	14.3750	13.5000	13.6250	13.7500	13.8750
15.....	41.5000	41.7500	46.5000	212.7500	211.7500	14.1875	14.2500	14.3125	14.3750	13.3750	13.4375	13.6250	13.6875
16.....	41.4375	41.8125	46.5000	211.7500	211.0000	14.0625	14.1250	14.1875	14.2500	13.2500	13.3125	13.5625	13.6250
17.....	42.0000	42.3125	47.0000	213.2500	212.5000	14.3125	14.3750	14.3750	14.5000	13.5000	13.5625	13.8125	13.8750
20.....	42.1875	42.5000	47.2500	213.7500	213.0000	14.3125	14.4375	14.4375	14.5000	13.5625	13.6875	13.8750	13.9375
21.....	41.7500	42.1250	47.0000	213.3750	212.7500	14.2500	14.3125	14.3125	14.3750	13.4375	13.5625	13.7500	13.8125
22.....	41.6875	42.0000	47.0000	212.5000	212.2500	14.1875	14.2500	14.2500	14.3125	13.4375	13.5625	13.6875	13.7500
23.....	41.3125	41.6250	46.5000	211.7500	211.7500	14.1250	14.1875	14.1875	14.2500	13.3125	13.4375	13.5625	13.6250
24.....	41.4375	41.7500	46.5000	212.2500	212.0000	14.1250	14.1875	14.1250	14.1875	13.3125	13.3750	13.5000	13.5625
27.....	42.1250	42.4375	47.2500	214.7500	214.5000	14.1875	14.4375	14.4375	14.5000	13.5625	13.7500	13.8125	13.8750
28.....	41.6250	42.0000	47.0000	213.5000	213.2500	14.2500	14.3125	14.2500	14.3125	13.4375	13.5625	13.6875	13.7500
Average for month...	42.188	.....	47.375	213.906	.....	14.283		14.417		13.522		13.780	

Prices for lead and zinc are the official prices for the first session of the London Metal Exchange; prices for copper and tin are the official closing buyers prices. All are in pounds sterling per long ton of 2,240 lb.

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(March 1, 1939)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb ..... 20c.
Antimony, domestic, spot, lb ..... 11.250c.
Bismuth, ton lots, lb $1.05
Cadmium, commercial sticks, lb ..... 55c.
Calcium, lb., ton lots 97 @ 98 per cent ..... 75c.
Chromium, 97 per cent grade, lb ..... 85c.
Nickel, electrolytic cathodes, lb ..... 35c.
Magnesium, 99.8 per cent, carolads, lb ..... 30c.
Palladium, troy oz $24.00
Platinum, (Official quotation) troy oz $35.00
Quicksilver, flask of 76 lb., 100 flasks or more ..... $88.00@$90.00
Radium, mg. radium content $40.00
Selenium, 99.5 per cent, lb $1.75
Silicon, minimum 97 per cent, spot, lb ..... 16.50c.
Tellurium, lb $1.75
Thallium, 100 lb. or more, lb $6.50
Titanium, 96 to 98 per cent, lb $5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton ..... $30.00@$35.00
Chrome Ore, 48 @ 50 per cent, c.i.f. Atl. ports, long ton ..... $22.00@$23.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:
- Old Range bessemer $5.25
- Mesabi bessemer $5.10
- Old Range non-bessemer $5.10
- Mesabi, non-bessemer $4.95

Lead (Galena) 80 per cent, Joplin, Mo., ton $52.94
Manganese Ore, c.i.f. Atlantic ports, long ton unit:
- 52 @ 55 per cent ..... 30c.
- 50 @ 52 per cent ..... 28@30c.
- 44 @ 48 per cent ..... 25c.

Molybdenum Ore, 90 per cent, per lb. of contained MoS_2 ..... 45c.
Tungsten Ore, per unit of WO_3:
- Chinese, 65 per cent, duty paid $19.00
- Domestic, 65 per cent and upward ..... (a)$16.00@$18.00

Vanadium Ore, per lb. of contained V_2O_5 ..... 27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton $29.00
(a) Prices at mines, small lots, usually several dollars less.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb 3c
Cobalt Oxide, 70 @ 71 per cent, lb ..... $1.67@$1.77
Copper Sulphate, 100 lb $4.50
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb $1.42
Sodium Sulphate, bulk ton ..... $13.00@$15.00

ALLOYS

Berrylium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be $23.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb ..... 10½c.
Ferromanganese, 78 @ 82 per cent, gross ton $80.00
Ferromolybdenum, 55 @ 65 per cent Mo. lb. of Mo. contained ..... 95c.
Ferrosilicon, 50 per cent, gross ton $65.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained $1.65

NON-METALLIC MINERALS

Asbestos, f.o.b. mines, ton:
- Canadian (Quebec)
  - Crude No. 1 ..... $700@$750
  - Crude No. 2 ..... $150@$350
  - Spinning fibers ..... $110@$200
  - Paper stock ..... $40@$45
  - Shorts ..... $12@$16.50
- Vermont
  - Shingle stock $57
  - Paper stock $40
  - Cement stock $25

Barytes, long ton:
- Georgia, crude $7.00
- Missouri, 90 per cent $BaSO_4$, less than 1 per cent iron ..... $6.00@$7.00

Bauxite, long ton:
- Domestic, chemical, 55 @ 58 per cent ..... $6.00@$7.00
- Domestic, abrasive, 80 @ 84 per cent ..... $12.00@$14.00
- Dalmatian, 50 @ 55 per cent ..... (a)$6.50@$7.50
- French, 56 @ 59 per cent ..... (a)$7.50@$8.50

China Clay, f.o.b. mines, ton:
- South Carolina and Georgia, No. 1, bulk ..... $6.75@$8.00
- Delaware, No. 1 ..... $14.50

Feldspar, bulk, ton:
- Potash feldspar, 200 mesh $17.00
- Glass-spar, white, 20 mesh $11.75

Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton $18.00
Fuller's earth, f.o.b. Georgia or Florida, ton ..... $7.00@$14.00
Magnesite, per ton:
- Dead-burned, f.o.b. California $25.00
- Dead-burned, f.o.b. Washington $22.00

Mica, per lb., North Carolina, No. 1 and 2 quality:
- 1½ x 2 in ..... 15@35c.
- 2 x 2 in ..... 30@50c.
- 3 x 3 in ..... 75@$1.00
- 3 x 4 in ..... $1.00@$1.30
- 4 x 6 in ..... $2.00@$2.50
- White, ground, 70 mesh, ton ..... $60.00@$80.00

Ocher, Georgia, ton ..... $19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports ..... (a) 12@12½c.
Silica, in bags, 325 mesh, ton ..... $18.00@$40.00
Sulphur, Texas mines, long ton $16.00
Talc, f.o.b. works, ton:
- New York, double air-floated, 325 mesh ..... $12.00@$15.00
- New Jersey, mineral pulp ..... $8.00@$10.00
- Vermont, extra white, 200 mesh ..... $9.00@ $9.50

Tripoli, Missouri, ton:
- 40 mesh, cream colored $14.50
- 200 mesh, cream colored $26.00

(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:
- Bessemer $21.50
- Basic $20.50
- No. 2 Foundry $21.00

Steel, base prices, Pittsburgh:
- Billets, gross ton $34.00
- Structural shapes, 100 lb $2.10
- Bars, 100 lb $2.25

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1938	1939	1938	1939	1938	1939
January	44.750	42.750	19.895	20.305	499.895	466.775
February	44.750	42.750	20.159	20.370	501.722	468.472
March	44.446	.....	20.088	.....	498.394	.....
April	42.750	.....	18.880	.....	498.046	.....
May	42.750	.....	18.731	.....	496.673	.....
June	42.750	.....	18.945	.....	495.772	.....
July	42.750	.....	19.356	.....	492.855	.....
August	42.750	.....	19.389	.....	488.044	.....
September	42.750	.....	19.300	.....	480.240	.....
October	42.750	.....	19.613	.....	476.785	.....
November	42.750	.....	19.834	.....	470.587	.....
December	42.750	.....	20.083	.....	466.798	.....
Year	43.225	.....	19.523	.....	488.818	.....

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine, London, pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot			
	Domestic		Export		Standard		(a) Electrolytic	
	1938	1939	1938	1939	1938	1939	1938	1939
January	10.198	11.025	9.908	9.912	41.387	43.125	45.387	48.440
February	9.775	11.025	9.525	9.735	39.597	42.188	43.563	47.375
March	9.775	.....	9.496	.....	39.772	.....	43.582	.....
April	9.775	.....	9.443	.....	39.306	.....	43.408	.....
May	9.375	.....	8.801	.....	36.668	.....	40.852	.....
June	8.775	.....	8.500	.....	35.235	.....	39.417	.....
July	9.585	.....	9.573	.....	39.744	.....	44.405	.....
August	9.900	.....	9.844	.....	40.591	.....	45.909	.....
September	10.028	.....	9.943	.....	41.864	.....	47.148	.....
October	10.760	.....	10.713	.....	45.646	.....	51.190	.....
November	11.025	.....	10.569	.....	45.244	.....	51.080	.....
December	11.025	.....	10.023	.....	43.428	.....	48.988	.....
Year	10.000	.....	9.695	.....	40.707	.....	45.411	.....

New York quotations, cents per pound. London, pounds sterling per long ton, (a) Bid quotation.

LEAD

	New York		St. Louis		London			
	1938	1939	1938	1939	1938 Spot	1938 3 mos.	1939 Spot	1939 3 mos.
January	4.870	4.826	4.720	4.676	16.135	16.253	14.534	14.744
February	4.632	4.805	4.482	4.655	15.402	15.525	14.283	14.417
March	4.500	.....	4.350	.....	15.992	16.075	.....	.....
April	4.500	.....	4.350	.....	15.579	15.623	.....	.....
May	4.400	.....	4.250	.....	14.210	14.376	.....	.....
June	4.148	.....	3.998	.....	13.969	14.012	.....	.....
July	4.882	.....	4.732	.....	14.921	15.034	.....	.....
August	4.900	.....	4.750	.....	14.371	14.480	.....	.....
September	4.998	.....	4.848	.....	15.249	15.401	.....	.....
October	5.100	.....	4.950	.....	16.173	16.313	.....	.....
November	5.091	.....	4.941	.....	16.088	16.223	.....	.....
December	4.842	.....	4.692	.....	15.106	15.275	.....	.....
Year	4.739	.....	4.589	.....	15.266	15.383	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton.

TIN

	Straits, New York		Standard, Spot, London	
	1938	1939	1938	1939
January	41.548	46.404	183.619	215.435
February	41.373	45.640	183.144	213.906
March	41.219	.....	183.473	.....
April	38.430	.....	168.612	.....
May	36.885	.....	162.693	.....
June	40.376	.....	177.429	.....
July	43.428	.....	192.542	.....
August	43.276	.....	192.966	.....
September	43.369	.....	193.733	.....
October	45.263	.....	206.911	.....
November	46.262	.....	213.909	.....
December	46.180	.....	214.450	.....
Year	42.301	.....	189.457	.....

New York quotations cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1938	1939	1938 Spot	1938 3 mos.	1939 Spot	1939 3 mos.
January	5.000	4.500	14.994	15.173	13.682	13.887
February	4.813	4.500	14.408	14.589	13.522	13.780
March	4.417	.....	14.364	14.477	.....	.....
April	4.141	.....	13.729	13.919	.....	.....
May	4.042	.....	12.682	12.869	.....	.....
June	4.131	.....	12.890	13.104	.....	.....
July	4.745	.....	14.144	14.371	.....	.....
August	4.750	.....	13.467	13.675	.....	.....
September	4.846	.....	14.040	14.246	.....	.....
October	5.012	.....	15.083	15.232	.....	.....
November	4.924	.....	14.366	14.550	.....	.....
December	4.500	.....	13.709	13.861	.....	.....
Year	4.610	.....	13.990	14.172	.....	.....

St. Louis quotations, Prime Western, cents per pound. London, pounds sterling per long ton.

CADMIUM AND ALUMINUM

	Cadmium			Aluminum	
	1938 (a)	1939 (a)	1939 (b)	1938	1939
January	117.500	70.900	58.400	20.000	20.000
February	117.500	67.500	55.000	20.000	20.000
March	117.500	.....	.....	20.000	.....
April	102.500	.....	.....	20.000	.....
May	102.500	.....	.....	20.000	.....
June	102.500	.....	.....	20.000	.....
July	102.500	.....	.....	20.000	.....
August	99.722	.....	.....	20.000	.....
September	84.000	.....	.....	20.000	.....
October	80.000	.....	.....	20.000	.....
November	77.717	.....	.....	20.000	.....
December	72.500	.....	.....	20.000	.....
Year	98.037	.....	.....	20.000	.....

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound; (a) average of producer's and plater's quotations; (b) producers' price, commercial sticks.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1938	1939	1938	1939	1938	1939
January	13.750	11.670	79.240	77.440	36.000	34.440
February	13.750	11.250	76.455	85.227	36.000	35.000
March	13.750	.....	72.444	.....	36.000	.....
April	13.654	.....	71.019	.....	36.000	.....
May	12.460	.....	74.640	.....	33.400	.....
June	11.731	.....	80.731	.....	33.231	.....
July	11.030	.....	76.860	.....	36.000	.....
August	10.880	.....	75.500	.....	37.000	.....
September	11.310	.....	74.420	.....	39.000	.....
October	12.060	.....	73.480	.....	37.960	.....
November	12.250	.....	74.065	.....	36.217	.....
December	11.567	.....	76.769	.....	34.000	.....
Year	12.349	.....	75.469	.....	35.901	.....

(a) Antimony, cents per pound, ordinary brands, in cases; in bulk deduct .250c. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum is dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1938	1939	1938	1939	1938	1939
January	24.50	21.50	23.50	20.50	24.00	21.00
February	24.50	21.50	23.50	20.50	24.00	21.00
March	24.50	.....	23.50	.....	24.00	.....
April	24.50	.....	23.50	.....	24.00	.....
May	24.50	.....	23.50	.....	24.00	.....
June	23.73	.....	22.73	.....	23.23	.....
July	20.50	.....	19.50	.....	20.00	.....
August	20.50	.....	19.50	.....	20.00	.....
September	20.50	.....	19.50	.....	20.00	.....
October	21.50	.....	20.50	.....	21.00	.....
November	21.50	.....	20.50	.....	21.00	.....
December	21.50	.....	20.50	.....	21.00	.....
Year	22.686	.....	21.686	.....	22.186	.....

Iron, dollars per long ton. F. o. b. Mahoning and Chenango Valley furnaces.

PERSONAL ITEMS

William V. Burley, assistant manager and comptroller of the Magnus Metal Division of the National Lead Company, has been appointed manager temporarily to succeed James A. Caselton, deceased.

Thomas B. Stearns, of Denver, received a fellowship and the Institute 50-year service medal at the annual meeting of the A.I.M.E. held in New York Feb. 12 to 16.

Anthony Strojan, a former engineer for Pickands, Mather & Company, is now in charge of gold mining operations for Winston Bros., of Minneapolis, at Helena, Mont.

Dr. Frank D. Adams, a past president of the Canadian Institute of Mining and Metallurgy, was recently awarded the Wollaston Medal of the Geological Society of London.

E. N. Pennebeker, geologist for the Consolidated Coppermines Corporation at Kimberly, Nev., has returned to that productive center from Cuba, where he has been engaged in professional work.

E. C. Stephens, recently chief engineer for Mountain City Copper Company in Nevada, has joined the staff of International Smelting Company, Salt Lake City, Utah, as field geologist.

G. S. Brooks, vice-president of the Silesian American Corporation and president of Giesche Spolka Akcyjna, at Katowice, Poland, is in London, England, on business.

Fred W. Nobs, for many years general manager of Empire Star Mines Company, Ltd., Grass Valley, Calif., has been promoted to vice-president in charge of development. **John Mann** succeeds Mr. Nobs as general manager.

George K. Foster and **C. Borror,** mining engineers for the Canadian Johns Manville Company, Ltd., Asbestos, Quebec, were recently in New York on business.

Francis R. Pyne, metallurgical engineer, has become associated with the Irvington Smelting & Refining Works, Irvington, N. J., as superintendent.

P. N. Pitcher has been appointed assistant general superintendent of the Cariboo Gold Quartz Mining Company, Wells, B. C. He was formerly mine engineer for the company, and from 1936 until recently was general superintendent of the Bayonne mine, B. C.

E. P. Leach, mining engineer, recently employed at the Zenith iron mine, at Ely, Minn., for Pickands, Mather & Company, has resigned to join the engineering department of Phelps Dodge Corporation in Morenci, Ariz.

Fred Buchanan, until recently with the New York & Honduras Rosario Mining Company at San Juancito, Honduras, Central America, is now employed by Desert Silver, Inc., at Silver Peak, Nev., as mill shift boss.

H. R. Robbins is retiring from active professional work following eleven years with the Oriental Consolidated Mining Company, first as consulting metallurgical engineer at the company's mines

H. R. ROBBINS

at Hokuchin, Chosen, and later as agent with headquarters in Glendale, Calif. The company has been compelled drastically to curtail all expenditures for equipment, supplies, and other purposes in this country, owing to the foreign exchange restrictions in effect in Japan.

L. C. Moore, long identified with the Mesabi range and the Cleveland-Cliffs Iron Company, has gone to Ishpeming, Minn., to become assistant to **O. D. McClure,** head of the mechanical department of the aforementioned company.

Kenneth E. Mackey recently joined the Rhodesia & General Asbestos Corporation as section manager of the Shabanie mine, Southern Rhodesia.

H. Foster Bain, mining adviser, Bureau of Mines, Manila, P. I., has been elected to honorary membership of the San Francisco Engineers' Club in recognition to his outstanding contributions to the mining industry as well as to the fact that he was one of the founders of the club.

Morley Shier has been appointed district manager of Canadian Industries, Ltd., for British Columbia and Alberta, with offices in Vancouver, B. C., succeeding **Colin S. Cradock,** who will remain with the company as consultant. Mr. Cradock has been associated with the explosives industry for thirty-six years.

A. F. Johnson, from Colorado, U.S.A., arrived in Australia last December to join the staff of Big Bell Mines, Ltd., Big Bell, near Cue, W.A.

Merle H. Guise, Alaska gold placer engineer, visited Toronto on his return trip from New York to the West Coast, where he has headquarters at the Olympic Hotel, Seattle, Wash.

R. S. Sanford has left Mexico, where he was employed for the past three years as chief mining engineer for the Fresnillo Company, and has been appointed mine and quarry superintendent for the United States Gypsum Company at Southard, Okla.

R. F. Bennett, inspector of mines at Cloncurry, Queensland, has resigned to join the technical staff of Imperial Chemical Industries of Australia and New Zealand, Ltd. He has been succeeded by **O. J. Carlson,** formerly mines inspector at Mareeba, Queensland.

J. E. Meinhardt, of Coeur d'Alene, has been named president of the Shamrock Silver Mining Company, operating in the Creek district. **J. G. Sullivan** will continue as mine manager and will start development work as soon as snow conditions permit.

R. M. Macaulay, general manager of Pamour Porcupine Mines, Ltd., in the Porcupine district of northern Ontario, accompanied by Mrs. Macaulay, is in Africa and will visit some of the mines in the Johannesburg area.

William Sharp, long in charge of mines and engaged in engineering work in Nevada, now manager for the Eureka Corporation Ltd., a Canadian group operating at Eureka, Nev., has been investigating Utah properties for Toronto interests.

Mark Bradshaw, president of the Bradshaw Syndicate, Inc., with offices at Tonopah, Nev., is preparing his tailing treatment plant, with capacity of 1,500 tons per day, for early resumption of treatment of impounded tailing from the 1,000-ton Goldfield Consolidated cyanide mill.

Fred C. Gebhart, secretary and associate of **S. Frank Hunt,** discoverer of the Mountain City copper deposits in northern Elko County, Nev., has been at Reno and Carson City. Hunt flew lately by Clipper plane to Hawaii for a vacation.

C. Earl Rodgers has recently moved to Toronto to take up general consulting work. For the past fourteen years approximately he has been general manager for Sylvanite Gold Mines, Ltd., at Kirkland Lake, Ont., and still retains a connection with that company as consulting engineer.

Allan James recently returned to the offices of the Pan-American Engineering Company in Berkeley, Calif., after two months spent in Montana testing jig operations on the dredges of Perry Schroeder Mining Company and Winston Brothers. These dredges were built in 1938 by Yuba Manufacturing Company.

R. C. "Bob" Duncan, formerly in charge of mines at Bodie, Calif., for the Bradley Mining Company and later manager for the Consolidated Chollar, Gould & Savage Mining Company on the Comstock lode, is superintendent of the Harvard mine of the Alaska Juneau Gold Mining Company near Jamestown, Calif.

George C. Lipsey has been transferred by the Britannia Mining & Smelting Company from Chelan, Wash., to Britannia Beach, B. C., where he succeeds **C. G. Dobson** as mine superintendent. **John J. Curzon,** formerly chief engineer at Britannia Beach, has been appointed general superintendent at Chelan.

Henry B. Hanson has been appointed general manager of San Francisco Mines of Mexico, Ltd., at San Francisco Del Oro, Chih., Mexico. He succeeds **E. A. Strout,** who retired as general manager on Dec. 31, 1938, after fifteen years of service in that position. Prior to his joining San Francisco Mines, Mr. Strout had served as manager of various properties of the Union Corporation in South Africa.

Louis S. Cates, president of Phelps Dodge Corporation, received the William Lawrence Saunders Medal of the American Institute of Mining and Metallurgical Engineers, highest award of the organization, at the Institute's annual banquet on Feb. 15, held at the Waldorf-Astoria, New York City. Former President Hoover, who received the medal in 1928, attended the dinner. The medal is awarded for "signal accomplishment in the conception and application of superior mining technique and in the organization and administration of major mining and metallurgical enterprises."

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OBITUARY

John Miller, mining engineer, of St. Regis, Mont., died early last month. He was 57.

Harry C. McAllister, 67, pioneer broker and mining man of Wallace, died in Spokane late in December.

Dr. Arthur Philemon Coleman, dean of Canadian geologists, died recently at the age of 86.

Robert Parker, recently appointed general manager of Rhokana Corporation, died recently at Cape Town, aged 51.

John R. Wettstein, who retired as president of the United Lead Company in 1928, died on Feb. 11 at the age of 71.

Karl Sundberg, long engaged in electrical prospecting in the world's mining fields, died at Stockholm, Sweden, on Feb. 3, at the age of 47.

Albert E. Brugger, consulting mining engineer, of Los Angeles, died on Feb. 12 from injuries received in an automobile accident near Ludlow, Calif.

Henry Louis, an English mining engineer internationally known for many decades, died in Newcastle on Feb. 22 at the age of 85.

Col. Thomas R. Marshall, consulting mining and metallurgical engineer, and formerly commandant of cadets at Virginia Military Institute, died at Richmond, Va., on Feb. 13, at the age of 79.

Harold Prather, metallurgical engineer, was recently killed in an automobile accident in Cleveland, Ohio. Mr. Prather was consulting engineer to the Non Ferrous Metal Trust of the Soviet Union during 1930–31.

Ernest Philip Herivel, prominent English mining engineer and mining companies' official for 36 years in Mexico, died Jan. 30 after a short illness in the British Hospital, Mexico City. Burial was in the Mexico City British Cemetery with Masonic rites. Surviving are a widow and a daughter. Mr. Herivel was engaged for many years in the El Oro region, State of Mexico. He also served with the Mexican Corporation at its Santa Gertrudis property, Pachuca, Hidalgo, and with mines at Teziutlan, Puabla. For a time, shortly before his death, he was general superintendent for the La Noria mines, Zacatecas.

James A. Caselton, St. Louis district manager of the National Lead Company, died Feb. 11, at St. Luke's Hospital in St. Louis. He was 54 years old. He had been with the company for 31 years and, in 1936, was made general manager of the St. Louis district, which covers 24 states. He also was an officer of the National pigment and chemical division, and the Combined Metals Reducing Company. As vice-president and secretary of St. Louis Smelting & Refining Company, a subsidiary of National Lead, he was well known in the Tri-State district. For years he was a director and treasurer of the American Zinc Institute.

▼ ▼ ▼

A LETTER

Operating Costs of a Small Gold Mine

The Editor:

TWO ARTICLES bearing on this subject were published in *E.&M.J.* last year. The first one, by Wiechmann and Becker (July, 1938, p. 47), referred to the Portland mine, in Mohave County, Ariz., with a daily production of 106 tons and total operating costs per ton of $7.2248. The second one, by J. A. MacKenzie (October, 1938, p. 60), described the performance of the Fairview Amalgamated Gold Mines, in British Columbia, almost ideally situated, treating about 130 tons per day for $3.17 per ton (depletion not included).

To give effect to the cordial invitation of the editor I should like to submit similar information to the reader, coming from a still smaller gold mine situated in the Netherlands East Indies, working under totally different circumstances than those already described.

The Goenoeng Aroem gold mine, at about 3,000 ft. above sea level, is situated in deeply eroded mountainous country on the West Coast of Sumatra. Transportation of supplies takes place by motor truck over 102 km. from the nearest seaport, Emmahaven-Padang. The last 15 km. is company road through jungle. The climate is good, with an average daily temperature of 25° C. and 18° C. at night. Rains are frequent and heavy, averaging between 6,000 and 7,000 mm. a year. The orebody is 700 m. long and extends over 250 m. vertical depth. Connected to the mill by a 2,000-ft. haulage tunnel, the greater part of the ore is hoisted through a 300-ft. vertical shaft and a 130-ft. inclined shaft. Stoping is done mainly in shrinkage stopes. The hanging wall is strong, but the vein is narrow, not being wider than 1.20 m. and often only 20-40 cm. wide, so that hand-picking is necessary.

However, very fine grinding is preponderant (1 per cent plus 200, 88 per cent minus 300-mesh), the ore floats readily, and a recovery of 91-92 per cent of the gold is made in an all-flotation mill, treating 60-67 tons of ore daily.

Costs per Dry Ton of Ore Milled

	July 1935-Dec. 1937 30 Months 60 Tons per Day	Jan.-Nov. 1938 11 Months 67 Tons per Day
Mine	$2.1162	$2.2120
Mill	1.3764	1.3967
Miscellaneous	0.9391	0.6617
Operating costs at the mines	$4.4317	$4.2704

Total charges per ton are available only for the first 30 months of operation, i.e., July, 1935, to December, 1937:

	July 1935-Dec. 1937 30 Months 60 Tons per Day	Jan.-Nov. 1938 11 Months 67 Tons per Day
Operating costs at the mine		$4.4317
Concentrate shipment to Amsterdam	$0.3578	
Costs and deductions of smelter	0.3784	
Total concentrate costs		0.7362
Prospecting underground and on surface	0.1241	
New machinery and capital development	0.3318	
Investment costs		0.4559
Office of company representative at Padang	0.1444	
Headquarters in Amsterdam	0.6362	
Concession taxes	0.0092	
General costs		0.7898
Total operating costs per ton		$6.4138
Depreciation per ton		$2.2522
Total charges per ton		$8,6660

In the above calculations the value of the guilder against the dollar is taken as follows:

July, 1935, to October, 1936 .. $1=f 1.49
October, 1936, to December, 1938 $1=f 1.84

From the tabulation it will be seen that depreciation plays an important part in the total charges per ton, due to a small ore reserve of only 105,000 tons. As the average value of 1 gram of gold during this period was $1.147, a total amount of only 7.55 g., or 0.242 oz., gold extraction per ton covered all costs.

P. M. MATTHYSEN
General Manager
Mijnbouw Maatschappij Barisan
Padang, West Coast, Sumatra,
Netherlands East Indies.

What Metal Statistics Show

EARLY IN MARCH metal producers found some comfort in the more encouraging business news, and sentiment on the outlook for copper, lead and zinc improved. Consumption of metals is increasing according to seasonal custom, and if the apparent peace objectives become more amplified in the business and political outlook both here and abroad, the mining industry stands to gain its proportionate share in any consequent industrial expansion.

Copper consumers have remained out of the market for some time, and many in the industry expect buying to increase soon, as supplies of metal in consumers' hands are low. Domestic sales of copper for the month of February totaled 19,844 tons, against 15,507 tons in January. Fabricators here shipped products in January that contained 59,000 tons of copper, against 55,000 tons in December. Statistics for January were better than anticipated by the industry, and taking a view of further curtailment here, plus greater consumption, producers hold that the statistical position of copper will steadily improve.

Effective March 1, the foreign producers of copper operating under the control plan restricted output to 95 per cent of the basic capacity. Operations since Jan. 1 by this group have been maintained at 100 per cent. Output on the new basis will reduce production by this group by 4,000 or 5,000 tons monthly. Domestic stocks of copper for January gained 11,355 tons and abroad the increase was 11,536.

The Copper Institute's figures for December and January, in short tons, follow:

	Dec.	Jan.
Production, crude:		
U. S. mine	60,683	55,230
U. S. scrap, etc.	11,112	13,818
Foreign mine	106,559	92,244
Foreign scrap, etc.	16,033	14,658
Totals	194,387	175,950
Production, refined:		
U. S. duty-free	67,947	66,182
Foreign	121,854	107,298
Totals	189,801	173,480
Deliveries to customers, refined:		
U. S. domestic	38,853	51,059
U. S. exports (b)	8,827	3,768
Foreign	(a)106,073	95,762
Totals	(a)153,753	150,589
Stocks at end, refined:		
United States	289,755	301,110
Foreign	167,413	178,949
Totals	457,168	480,059

(a) Revised. (b) Duty-free copper.

▶ ZINC—Stocks of zinc gained only 1,616 tons in January and production was virtually the same in December, being 44,172 tons in January, against 44,878 tons in December. Though consumption of all common grades of zinc has been steadily increased, low prices for the metal have steadily shut off production at many mines, with a consequent rise in unemployment as a result of the new zinc tariff. In February, however, a slight reduction in stocks occurred, the total involved being only 211 tons.

The figures for January and February, in tons, according to the American Zinc Institute, follow:

	Jan.	Feb.
Stock at beginning	126,604	128,220
Production	44,142	39,512
Production, daily rate	1,424	1,411
Shipments	42,526	39,723
Unfilled orders	34,179	29,987
Stock at end	128,220	128,009

The Prime Western division produced 18,266 tons during February, against 19,659 tons in January. Shipments of the common grades amounted to 15,927 tons during February, against 16,786 tons in January. Stocks of those grades totaled 54,214 tons at the end of February, against 51,875 tons a month previous.

▶ LEAD—Production of refined lead as shown in the January statistics was 38,299 tons, against 30,988 tons in December, or an increase of 7,311 tons. This gain in output is believed to have resulted, in part, from the large year-end shipments of accumulated lead concentrates in the Tri-State district, and should not, therefore, be considered as representing the current rate of production. Shipments to consumers in January were 40,189 tons, against 33,908 tons in December, but since production was higher, stocks increased slightly by 1,312 tons. With production estimated by producers to be around 35,000 tons, and shipments to consumers around 40,000 tons, a decrease in stocks is expected for February.

The December and January figures on refined metal compare as follows, in short tons:

	Dec.	Jan.
Stock at beginning	115,134	115,902
Production:		
Domestic ore	30,988	38,299
Secondary and foreign	3,695	3,208
Totals	34,683	41,507
Domestic shipments	33,908	40,189
Stock at end	115,902	117,214

The following tabulation shows total lead stocks at the works of smelters and refiners in the United States so far as reported, in short tons:

	Dec. 1	Jan. 1
In ore, matte, process (a)	60,060	56,332
In base bullion:		
Smelters and refineries	11,750	18,693
In transit to refineries	1,759	2,339
In process at refineries	14,523	16,690
Refined lead	103,950	102,489
Antimonial lead	11,184	13,413
Total stocks	203,226	209,956

(a) At smelters.

United States Consumption of Primary Tin

(American Bureau of Metal Statistics)

The following statistics are intended to indicate actual absorption of tin into manufacture, and, therefore, are quite distinct from intake of supplies. Naturally, the accounting for deliveries and use in manufacture do not balance, for there are ever increases and decreases in invisible stocks between those two positions. Our estimates for use in manufacture are not sufficiently close to determine exactly such flux, but they disclose the general trend. The use of tin for tin-plate manufacture is revised quarterly so as to harmonize with the reports of the American Iron and Steel Institute. The figures are in long tons.

	Tin-plate	Babbitt	Solder	Bronze, Tubes, and Foil	Other Uses	Total Consumption	Deliveries, Foreign (a) Tin
1933	28,910	2,640	7,080	9,630	12,800	61,060	57,815
1934	24,447	2,810	8,620	10,400	7,000	53,277	46,215
1935	28,942	3,020	11,480	9,300	9,200	61,942	59,110
1936	35,442	3,690	11,880	12,300	10,700	74,012	74,005
1937	41,012	3,360	11,780	11,200	10,800	78,152	83,665
1938:							
January	1,560	180	630	600	750	3,720	5,550
February	1,980	150	570	600	700	4,000	4,420
March	2,090	190	630	710	750	4,370	4,555
April	2,220	160	620	650	700	4,350	3,745
May	2,030	140	630	620	700	4,120	4,275
June	1,870	160	620	600	700	3,950	4,205
July	1,880	170	590	590	700	3,930	3,775
August	1,900	200	650	650	700	4,100	3,775
September	1,520	190	700	660	700	3,770	4,465
October	1,700	170	720	770	700	4,060	4,960
November	1,800	200	720	740	700	4,160	3,535
December	2,000	210	740	680	700	4,330	3,400
Totals	22,550	2,120	7,820	7,870	8,500	48,860	50,660

Under the head of other uses are included terne plate (beginning with 1934), pipe, pewter and other white metal alloys, castings, tinning copper sheet and wire, stannic oxide and chlorides, and miscellanies.

(a) Commodity Exchange, Inc.

CALIFORNIA

Murchie Mine May Be Closed Soon

Development in depth steadily proves disappointing — Climax mine in Amador County will be reopened — Pride of Mojave mill placed in operation

▶ According to a report from Nevada City, the Murchie mine, operated by Empire Star Mines Company, Ltd., may soon be shut down. Underground development work on the deeper levels has been disappointing for several years. Work throughout the last 1,000 ft. on dip has shown, level by level, a gradual decline in grade of ore and a decrease in the length of individual oreshoots. There have also been changes in the character of the mineralization. Save for a few scattered and minor items of development work which remain undone, present activities are confined to the extraction of the remaining tonnage of commercial ore. In an effort to provide employment for the men who have worked in the mine for more than one year, and who, in case of sudden suspension, could not be absorbed by other company operations without loss of time, the company is now filling vacancies at the Empire, North Star, and Pennsylvania mines, in Grass Valley; the Zeibright, at Bear Valley; and the Pennsylvania, at Brown's Valley, with Murchie miners. These transfers will be continued until only a small number of hoist, maintenance, and shop men remain. Vacancies at the Murchie mine, caused by the transfers, are being filled with newly employed men. Though the development of the Banner section of the company's holdings is under consideration, no definite decision has been reached. The Murchie mine is a short distance from Nevada City, and is equipped with a 300-ton flotation plant. Robert J. Hendricks is general manager.

▶ The Climax mine, near Pine Grove, Amador County, is to be reopened and mining operations are to be resumed, following a shutdown since early in 1936. A. J. Ragio, of Jackson, will be in charge of operations.

▶ The latest reduction plant to be placed in operation in the Mojave mining area is the flotation mill completed recently by the Pride of Mojave Mining Corporation at its Pride of Mojave and Four Star properties. Capacity of the new unit is 75 tons, and design and equipment used follow those of the newer flotation plants in the State. J. J. Murray is in charge of operations.

▶ Leasehold rights and equipment of the San Andreas Dredging Company, which has carried on dragline dredge operations near San Andreas, Calaveras County, under partnership of E. M. Clark and L. G. Graves, have been taken over by Charles H. Thurman, consulting engineer, 420 Market St., San Francisco, and president of Snelling Gold Dredging Company and manager of Lewiston Gold Dredging Company. Dredging work with the available equipment will continue under the direction of J. M. Sobrero, superintendent.

▶ The Grass Valley Bullion mine, near Grass Valley, Nevada County, is producing steadily, and about 70 tons of ore are being trucked to the mill of Idaho Maryland Mines Corporation at Grass Valley. Current underground activities are reported centered on the 2,200 level opened by a 500-ft. winze from the 1,700 level. Improvements made recently underground include electrification of haulage operations. The mine is operated by Grass Valley Bullion Mines, Inc., with H. Dennis, superintendent, directing the work.

▶ Lode Development Company has increased its holdings in the Garden Valley mining area of El Dorado County by the acquisition of the Taylor property. The mine is developed to a depth of 1,200 ft., and adjoins the Rosencranz mine, operated by the company. A drift advanced from the Rosencranz to the Taylor property will be completed soon. The 100-ton mill is operated two shifts, and about 25 men are employed under Charles H. Brown, superintendent.

UTAH

Vehicular Tunnel Opened At Utah Copper

Photo-electric cells regulate traffic through 7,000-ft. passage—Silver King Coalition Mines Company will resume operations after shutdown since May, 1938

▶ Utah's longest vehicular tunnel, that driven through the Utah Copper Company's property to connect Bingham with Copperfield, went into operation early Feb. 4. At a cost of $1,400,000, the Utah Copper Company has completed the 7,000-ft. tunnel so that it may mine ground crossed by the old highway. The first passengers to use the tunnel were County Commissioner J. B. Mullins, who accepted the gift of the new underground highway for Salt Lake County, and L. Buchman, superintendent of mines for the Utah Copper Company. Width of the tunnel is 12 ft. 4 in. A concrete arch reinforced with steel supports the roof. A 4-ft. walk is raised above the surface of the road for the use of pedestrians. Passageways for power- and water-lines, sewage, and drainage are provided below the floor of the tunnel. A ventilating system keeps the air pure. As the tunnel affords space for but one-way traffic—alternated every six minutes—photo-electric cells are placed in the tunnel to regulate traffic and the traffic-actuated doors at each end.

▶ Directors of the Silver King Coalition Mines Company have voted to resume operations at the Park City property, which suspended production on May 1 of last year. Up to that time, the mine had employed 450 men and shipped 500 to 600 tons of concentrate weekly. One of the principal reasons for the change in policy, said the company's statement, was to take advantage of the present price of silver. James Ivers, Kearns Building, Salt Lake City, is vice-president and general manager.

▶ Building of a miners' hospital at Ogden for treatment of silicosis patients; making the average of three years' net proceeds the basis for assessed valuation of ore in place rather than the proceeds for just one year; and broadening the workmen's compensation law to include occupational diseases are some of the measures bearing upon mining being discussed by the 1939 State Legislature.

▶ Fifty-seven workers of the Utah Copper Company, who had been employed continuously for 20 years, were honored recently at a dinner given at the Hotel Utah, attended by President D. C. Jackling, D. D. Moffat, vice-president and general manager, and Charles T. S. Parsons, cashier and assistant secretary. Gold lapel buttons were presented to the "class of 1938." Members of other classes reaching as far back as the class of 1926 were also guests of honor.

The class of 1938 consisted of: Peter Arata, A. E. Aston, H. S. Bouck, Max Brisk, J. W. Cahoon, Ernest Daybell, Clyde Dean, Louis DeCol, Framelio Disera, J. L. Gibbons, W. H. Gourley, J. G. Hadley, E. H. Hansen, F. L. Hibler, S. D. Huish, E. L. Jensen, H. C. Lloyd, D. J. Long, A. H. Maiben, L. J. Mantle, Jay McAllister, P. P. McCleve, H. A. McMaster, J. L. Moore, Albert Oscar Morris, Anders P. Nielsen, J. G. Novak, P. A. Olsen, A. L. Pappas, J. S. Park, J. F. Peel, M. M. Pettersson, Herman Poelman, J. C. Poulsen, E. I. Rhodes, Andrew Rigler, F. L. Riley, D. H. Rouse, Martin Saathoff, Dishiro Sake, P. R. Schultz, Andreas A. Siouris, Edwin Slater, William J. Snow, A. R. Taylor, Francis Titcomb, J. E. Tomlin, H. A. Tuck, C. E. Turner, E. W. Wahlin, Harry C. Watkins, Kenneth H. Watkins, S. J. Westerman, C. Douglas Wiest, H. G. White, W. W. Williams, and Thomas Wilson.

▶ The Park City Utah Mines Company has gained an easement through the Star of Utah tunnel, belonging to the New Park Mines Company. Signing of the agreement is interpreted as foreshadowing a resumption of operation by the first-named company after several years' inactivity.

▶ Two diamond drills are being operated at Harbro Mines on Polar Mesa, Grand County, Utah, for further development of these vanadium and uranium properties, owned and operated by William Albert Harbison, of New York, and Ralph W. Harbison, of Pittsburgh. One to two cars have been shipped each month during the past year. Operations are under the direction of Robert Linton, of Los Angeles. Robert Hamill is in charge at the mines, with headquarters in the Electric Building, Grand Junction, Colo.

▶ The Great American Prospectors Association, with headquarters in Salt Lake City, has passed a resolution in which the Congress is urgently requested not to extend further the exemption of annual assessment work on unpatented mining claims. The association is grateful for exemption during the depression, but feels the time has come when it is no longer necessary or advisable.

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IDAHO

Silver Producers Active In Coeur d'Alene

Many properties in district developing lower ore horizons, and shaft-sinking programs hold attention of operators—Condor Gold Mining Company takes over Treasure Gold mine, in Lemhi County

▶ The silver belt of the Coeur d'Alenes continues to be the most active region in Idaho for development work and exploration for orebodies. The big lead-silver producers of the district, the Bunker Hill & Sullivan, Morning, Hecla, and Page, are all working on a normal five-day week basis. Only a limited amount of work is reported in other sections of the district, but in the silver belt the search for new bodies of silver is being pushed and the coming spring gives promises of enlarged mining operations. The Sunshine is now opening one of its most important disclosures on the deep 3,100 level, where the orebody is 8 ft. wide and carrying better than 50 oz. of silver to the ton. Polaris is deepening its shaft, having recently dropped from the 1,900 to the 2,300 level, to the 2,900 level. The mill is handling 175 tons daily. Coeur d'Alene Mines, scene of recent ore disclosures, has contracted for 400 ft. of shaft work from the 2,000 level. Raises will be driven to explore the ore showing on the 2,000-ft. level. Silver Summit has opened a wide vein on the 600 level that is being developed. Shaft sinking will continue to the 1,000 level, according to Manager Harry Pearson, of Wallace. The ledge cut on the 600 level is one of the widest in the silver belt, having a width of 17 ft. Mineral Mountain is sinking below the 250-ft. level and expects to cut the vein within a short distance, according to Fred Theil, Wallace, president. Silver Syndicate is undergoing deep development work by the Sunshine company management from the 1,900 level of the Sunshine, the properties lying adjacent to each other. Sunshine Consolidated, adjoining Sunshine on the west, is being explored from the 1,700-ft. level of the Sunshine shaft, with work pointing toward the deep-seated orebodies of the Crescent mine of the Bunker Hill. Metropolitan Mines, south of the Sunshine, is under steady shaft development work, with an extensive exploration program being mapped for the future, according to Roy Kingsbury, Wallace, secretary. Several other silver belt properties are undergoing more or less work this winter, and others, such as the Merger Mines, Silver Bowl, St. Elmo, and American Silver, will be active in the spring. Approximately 900 men are now employed in the mines, and prospects appear good that this number may be increased in the spring.

▶ Condor Gold Mining Company, a subsidiary of the International Smelting & Refining Company, has taken over the Treasure Gold mine, in the Yellow Jacket district of Lemhi County, for a purchase price of $205,000. Henry M. Martman, general superintendent of the Rio Tinto mine, has been appointed superintendent of the new operation.

▶ A bill introduced in the House of Representatives of the Idaho State Legislature calling for an increase in the State mine tax from 3 per cent to 5 per cent was defeated.

▶ Four seniors in the University of Idaho School of Mines will benefit each year under terms of a memorial scholarship established by directors of the Sunshine mine in honor of their late president, A. E. Larson, of Yakima, Wash.

New Mining Association In Oregon

▶ The Oregon Mining Association, Inc., was recently organized in Portland. The objectives of the association are to unite in closer relationship persons interested in the development of Oregon's mineral industries; to promote good will between the people of the State and those engaged in the metal and non-metallic mining, and by united action and counsel to oppose unreasonable legislative measures and regulations detrimental to the prosperity and expansion of the mineral industry in Oregon. Officers of the association are Leverett Davis, president; D. Ford McCormick, vice-president; and F. Whalley Watson, secretary-treasurer, with office at 2250 N.E. Flanders St., Portland, Ore.

NEVADA

New Cyanide Plant for Comstock Lode

Consolidated Sierra Mining & Milling Corporation, which acquired Arizona Comstock Corporation, will erect plant—Sutro Tunnel Coalition, Inc., repays $160,000 RFC loan

▶ Construction of a 400-ton cyanide plant and of additions to its present 400-ton flotation mill will be started soon by the Consolidated Sierra Mining & Milling Corporation, which has acquired old bonanza mines on the Comstock lode at Virginia City formerly operated by the Arizona Comstock Corporation. Sale of the properties by J. M. Leonard, trustee, for $720,000, to William N. Albee, 2404 Eaton Tower, Detroit, Mich., president of the Consolidated Sierra Corporation, was approved by Judge F. H. Norcross of the Federal district court. The properties embrace the Savage, Hale & Norcross, Chollar, and Potosi mines, with early-day production from three bonanza orebodies in excess of $53,000,000 and with a present reserve in underground and surface ore, mine dumps, and flotation-mill tailing estimated at slightly over 2,000,000 tons, and having a gross value of $15,530,420. A comprehensive sampling and report have been completed by Royal D. Gardner, vice-president and mines manager for the Consolidated Sierra Mining & Milling Corporation. Underground workings to a depth of 880 ft. will be prepared for production and mill capacity will be increased to 800 tons per day. Heavy metallurgical losses involved in the former treatment of oxidized ore by flotation will be averted by cyanidation of the entire mine output.

▶ Repayment of an RFC loan of $160,000, the first mine loan to be made by the Federal agency, has been completed by the Sutro Tunnel Coalition, Inc., wholly-owned subsidiary of the Comstock Tunnel & Drainage Company, operating the Crown Point mine and adjoining ground on the Comstock lode at Gold Hill. Out of the total, the sum of $55,000 was expended for rerouting the tracks of the Virginia & Truckee Railroad and removing a high railroad trestle that stood directly over orebodies now being mined. With the remaining $105,000 the company constructed a cyanide mill of advanced design that has been treating 120 tons per day, part of the product being mined from open cuts by power shovel. Some payments to the RFC were made in advance and the loan was retired in less than three years. James M. Leonard is manager, employing 40 men in the mine and mill.

▶ Property of the Lucky Boy Consolidated Mines Company, four miles southwest of Hawthorne, in Mineral County, has been acquired under option of purchase from John H. Miller, president and controlling factor, by a group of Duluth, Minn., men in association with Capt. K. M. Harris, of Minneapolis.

▶ An inside shaft sunk from the 600-ft. tunnel of the Mountain City Consolidated Copper Company is nearing a depth of 200 ft. below the adit level, at which point a crosscut will be driven north to prospect for the Rio Tinto ore-channel, indicated to be around 60 ft distant. The shaft has exposed seams of sulphide material sampling as high as 30 per cent copper.

▶ First carload of gold ore was shipped lately from new workings of the Nevada United Gold Mining Company, reopening the Gold Dome property, at McCoy, 30 miles south of Battle Mountain in Lander County, under the direction of Julius G. Reeder, president and manager. Mr. Reeder, who makes his office headquarters at Battle Mountain, is receiving proposals for construction of a cyanide mill at the McCoy mine.

▶ Development work conducted during the past two years on the old Bluster mine, at Jarbidge, Elko County, by the Crater Range Mining Co., has exposed large bodies of gold-silver ore of excellent mill grade, according to reports by E. R. Lund, superintendent, who is associated with G. M. Grant in control of the operating company.

▶ The Penelas Mining Company, operating a gold-silver mine and 50-ton cyanide mill near Ione, Nye County, has filed a plan of reorganization with the Federal court at Carson City, having filed a petition in bankruptcy June 1 last, showing liabilities of $175,580. Indebtedness, in the form of unsecured notes, has been reduced to $119,000. The shaft has been sunk from the 600- to the 800-ft. point, and orebodies of high value are said to have been opened on new deep levels. The new petition lists cash on hand at $25,232 and the reserve of positive and potential ore at $576,700 gross. L. D. Gordon is manager.

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HOW THEY WORK

Sketch shows how the arms swing upward and backward on hinges when an overload is encountered

Two 70' diameter Dorr Torq Thickeners at mill of East Malartic Mines Ltd.

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That assurance is *structural*—in the form of the fully proved automatic overload relief built into Malartic's two 70' diameter Dorr Torq Thickeners.

If overloads occur in these Thickener tanks the increased torsional load simply causes the rake arms to swing up and slightly back—pivoting at the center. Thus automatically—without the aid of a rake lifting device—they ride over the obstacle.

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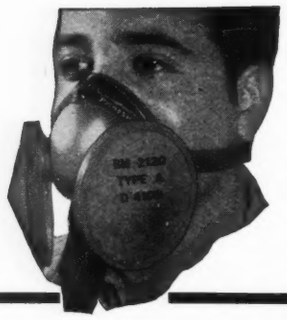

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MONTANA

Anaconda Copper Reopens Orphan Girl Mine

Washoe concentrator also resumes operations—Starpointer Exploration Company will continue testing placer gravels in Clarke Fork River—Montana Silver Queen Mining Company considers raising output

▶ On March 6 the Anaconda Copper Mining Company reopened the Orphan Girl mine, an important zinc producer. The Washoe concentrator, situated in Anaconda, Mont., also reopened on the same day. About 350 men returned to work.

▶ In the annual report of the Butte Highland Mining Company, W. S. Norman, president, states that in a fourteen-month period ended Dec. 31, 1938, the gross extraction was $339,668.62 out of 20,830 tons of dry ore averaging $16.30 a ton. Taxes paid represented 8.8 per cent of total income, or $1.44 a ton milled. The company's financial position is satisfactory, with cash on hand amounting to $46,527.52, out of which 1939 taxes will be paid. Dividend No. 2 was paid Jan. 9, 1939, amounting to $21,458.51. Development work has been successful in maintaining adequate available ore in sight, and in addition to the oxidized ores which have constituted the main objective of the program in the past, a new body of sulphide ore has recently been disclosed. W. L. Bell, manager, suggests that with a probable necessity of adding additional separate milling facilities to treat the sulphide ores, expansion of milling facilities to 150 to 200 tons a day appears justified.

▶ It is reported that the Starpointer Exploration Company, a closed corporation of San Francisco, Calif., which has been operating two Keystone drills on the Clark Fork River since October, 1938, plans to continue the test during the coming season. If results are satisfactory, it has been reported that dredge construction may be started this coming summer. Testing is under the direction of King C. Laylander.

▶ Under the supervision of Harry Parrent, exploration in the Gold Hill district near Maiden, Fergus County, Mont., will be increased by the installation of a compressor and other equipment this spring. This work is being done in the syenite rocks only a short distance from the Spotted Horse, McGinnis, and other well-known, early-day producers of the area. Chicago interests are reported to be financing the work.

▶ According to reports from Deer Lodge, the Bomull Exploration Company, of Spokane, operating the Emery mine, shipped 80 tons of gold ore during January. This property had been idle for many months. It is expected that after unwatering and reconditioning are completed, milling will be resumed.

▶ House bill No. 55, introduced in the current session of the Montana Legislature, pertaining to regulation of the interpretation of a mine shift on a basis of time from collar to collar, was unfavorably recommended out of committee and killed by the house. A similar bill appeared at the last session and was likewise rejected.

▶ It is reported that plans are being considered by the Montana Silver Queen Mining Company to increase its milling capacity. For about eight months the production has been held to about 60 tons a day under the management of Joseph Lancaster, formerly of Spokane. Gross production from August to November, 1938, was reported to be $76,264, and on Dec. 1 all obligations were said to have been retired, including the final payment on the mining property, which is situated on Snow Creek and was formerly known as the Big Seven mine.

COLORADO

Rico Argentine Mill Starts Operations

Newly erected 150-ton plant is of modern design—Alma district maintains steady gold output—Gold Chloride and Milton mines, in Clear Creek County, reopened

▶ Operation of the Rico Argentine Mining Company's new flotation mill at Rico, Colo., will begin as soon as ore passes connecting the haulage level with upper workings are completed. C. T. Van Winkle, consulting engineer, Dooly Block, Salt Lake City, Utah, makes this report to stockholders. Edward Bauer is mine superintendent and K. L. Erickson, mill superintendent.

▶ The mines and mills in the Alma district look forward to an active 1939. London Butte Gold Mines Company had a favorable production from the Butte mine; W. A. Ellis, Inc., shipped high-grade ore from the American Mine; London Mines & Milling Company operated the 200-ton mill with ore from the London Extension, North London, and the Consolidated London through the London Extension tunnel. The Alma Syndicate Inc., the Dauser, Hock Hocking, Excelsior, and other small properties shipped ore and concentrates during the year, and similar if not greater activity may be expected in 1939.

▶ A number of mining men in the State are reported making preparations to try out the new Scotch process of gold extraction this spring. George D. Gillespie has designed his own roaster for experimental purposes, and will build it this spring. The Scotch process of gold extraction combines roasting, amalgamation and flotation. In the past flotation has been placed ahead of roasting in the mill flowsheet. This new process reverses that procedure, and places flotation last, roasting first.

▶ The new strike at Bassick mine made by Higgins and Gay has increased in value and size. A sorting house and bin have been built and the ore will be shipped to Leadville for smelting. Messrs. Henning, Kettle, and Stoehkle have cleaned out and retimbered the Nemeha tunnel, adjoining the Bassick mine. The P and O property, adjoining the Bassick on the north, will soon be opened, according to T. M. Howells, local representative.

ARIZONA

Mammoth-St. Anthony Takes Over Two Mines

Properties formerly held by Molybdenum Gold Mining Company have been acquired — Tennessee-Schuylkill suspends operations — Mineral Mountain Mining Company will erect mill

▶ Foster S. Naething, general manager of the Mammoth-St. Anthony, Ltd., reports his company as having taken over operation of the Mohawk and New Year mines, at Mammoth, formerly worked by the Molybdenum Gold Mining Company. The 300-ton mill on the Molybdenum Gold property has been treating ore from both properties. Mammoth-St. Anthony is employing approximately 260 men and is treating about 550 tons daily.

▶ Operations at the Tennessee-Schuylkill mine and mill, at Chloride, were recently suspended due to low metal prices. Work is expected to resume when metal prices reach satisfactory levels.

▶ The mill at the property of the Hope Metals Company, Winkelman, is being remodeled for a 200-ton daily capacity. The work is being done under the direction of Dr. Arthur C. W. Bowen. A crew of fifteen men is employed.

▶ A crew of five men are sinking a shaft on the Rich Hill mining property, between Florence and Superior, to tap ores located by drill holes. N. L. Lampton, of Phoenix, is directing the work.

▶ Mineral Mountain Mining Company, of Florence, is preparing to install a milling plant at the Trexel mine, in the Mineral Hill district. The mill is planned to have a capacity of 200 tons and will treat gold and copper ore. W. D. Cochran is general manager.

▶ It is reported that the Bunker Hill Arizona Mining Company, at Sombrero, Butte, will resume operations April 1. The company completed the construction of a new 50-ton flotation plant at the property last year. Charles R. Dobler, 1325 Westmore Ave., Everett, Wash., is president of the company.

▶ A California group has taken over the old Fortuna mine, situated about 30 miles southeast of Yuma. A new shaft is being sunk to replace the old one, which is caved. A crew of fifteen men is employed.

▶ Lucy Bell Mining Company plans the expenditure of $50,000 for new machinery and rehabilitation work at the Lucy Bell mine, in Ash Canyon near Hereford. About 25 men are to be employed. The mine was developed about ten years ago and was shut down in 1931. The financing is reported to come from New York. Frank Bowling is general manager.

▶ The Columbus group of claims in the Maynard district in the Hualapai Mountains 20 miles southeast of Kingman has been taken over by San Francisco interests.

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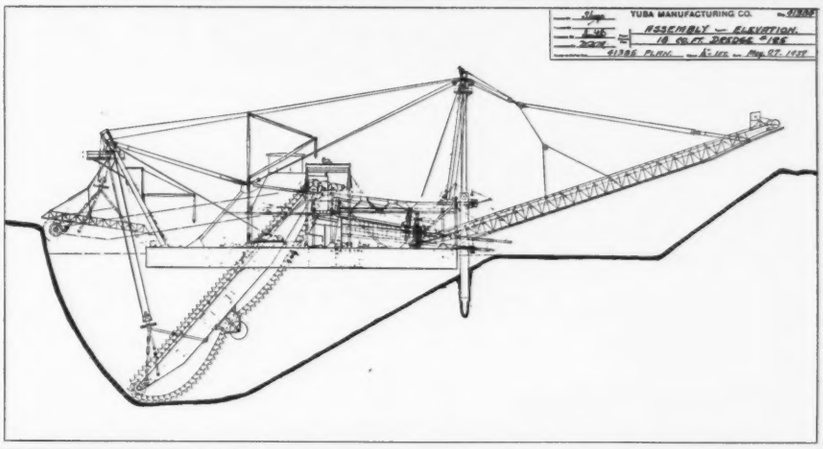

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NEWS FROM Washington

By Special Correspondent

SPEED in mineral supply will be the test of preparedness. The only way to plan for a military emergency is to BE ready. When trouble starts it is too late to GET ready. All this, a rather obvious philosophy, has taken new root in Washington, and will govern much of the military planning that is important to the mineral industries.

Establishment of stockpiles as a reserve for emergency will be planned in the case of those commodities for which domestic production might develop slowly, as well as for those commodities for which United States reserves are either inadequate or altogether unavailable. This fact accounts for much talk about reserves of certain minerals like tungsten or vanadium, for which domestic supplies could, and ultimately would, be developed from United States resources, given time.

As a matter of fact, the most important job confronting some of the special commodity subcommittees of the Mineral Advisory Committee will be this determination of the size of the stockpile needed in relation to possible later United States production. And, as every mineral economist knows, there are areas over which an indefinite controversy may rage—and probably will—during the coming months.

Tin and Quicksilver

DESPITE much difference of opinion on other mineral commodities, there seems to be little ground for argument that tin and quicksilver are two metals for which the United States absolutely must have a substantial mineral reserve in stockpile form. But the similarity between these two stops right there. Two differences of large policy importance to many divisions of the mining industry are noted.

There appears to be no doubt that the United States could produce ores and could recover from these ores substantial quantities of quicksilver at a price. Even those who argue for a very large military reserve do not deny domestic possibilities. But the time which it would take to get American production up to satisfactory levels would be great. And even the proponents of American development do not deny that it would cost a lot more to do so rapidly than it would cost to build a stockpile.

Seemingly only the ardent advocates of development of certain specific tin occurrences presume to argue in the same way for a domestic tin industry. A substantially larger number of persons favor establishing a tin-smelting business to work on Bolivian ores, and even urge that the United States should buy out certain Bolivian properties where deep mining has made for very high costs lately. But there is hardly a career man of the Government who will say a good word for either of these two proposals. And still there is great evidence of political activity on tin, quite in contrast with the situation surrounding quicksilver. Perhaps only manganese has stronger interest for the politically minded than does tin.

Despite dollar differences and politics, all the military units would like to pile up generous stocks of quicksilver in flasks and tin in pigs. The interest in quicksilver is by no means lessened because of Franco victories in Spain, which place both Italian and Spanish supplies under a single management.

The Alloying Elements

MODERN peace-time civilization cannot do without the ferro-alloys. Military operations are even more dependent on them. Every important alloying element from manganese to uranium is, therefore, on one of the preparedness lists. But the reasons why they are there and the status within the lists vary considerably. There is even substantial difference of opinion among well-informed mineral economists as to the proper placing of some of these metals. Bona-fide technical studies are likely to minimize these differences as the special subcommittees advising military authorities carry on their work. Right now the situation appears something like this:

1. Manganese—There is no item of mineral nature on any strategic list of more serious significance than ferro-grade manganese ore. Despite all the political claims, there is almost unanimous opinion among disinterested observers, and seemingly unanimous agreement among career officials, that a huge manganese stockpile is needed. The dollar estimates for this purpose would unquestionably be the greatest of the entire list of strategic commodities.

2. Chromium — Probably second in military importance and in cost for proper reserves is chromium ore. The propect of domestic production in time of military emergency is, however, definitely greater than for manganese. Official estimates indicate that rather soon 25 per cent of the United States requirements could be cared for, and that 100 per cent provision for the needed 100,000 tons per year of ore could probably be made within two years. The recommended stockpile is, therefore, only 250,000 tons.

3. Tungsten—Despite strong domestic development recently, military authorities still keep tungsten ore or tungsten concentrates on the strategic list. But unpublished information indicates that available tungsten capacity in the United States has now advanced close to the level of peace-time requirements. Ore reserves have been definitely staked out in quantities greater than were known even a few years ago. Some modest stockpile is probably agreed upon as desirable by most interested groups. But the defense of that need is almost altogether on the ground that it is cheaper to carry a small military reserve than it is to force over-rapid development in time of military emergency to take up the sudden new demands that would then be encountered. Even the pessimists do not think that the United States would have to do without tungsten in case of military emergency; but they do claim that the price would go up a bit too much for comfort, if there were no stockpile at all.

4. Vanadium and Titanium — These two commodities used to be considered as strategic; now they are merely "critical" materials. And the chances are that the present capacity of production of both is distinctly greater than even military demands would impose. Certainly within six months, with nominal expenditure for such things as boilers, roasting equipment, and the like, the United States industries could more than care for both civilian and military requirements. This is particularly true of vanadium, which has been advanced in the United States amazingly within the last three or four years.

5. Minor Alloys—Markedly less important to the military agencies are molybdenum, uranium, zirconium, and such rarer elements as columbium. Even the conservative military list makers put these commodities way down on their "essential" list. United States industries either are abundantly supplied with their own sources, or carry commercial stocks that would probably be adequate even with interrupted ocean shipping.

The Commercial Problem

EVEN if all the experts agreed on the foregoing classifications of the strategic minerals, there would remain several important commercial aspects of the preparedness problem. Mineral economists are struggling with these. It is recognized that they must be solved to the satisfaction of the mining and mineral industries, or full cooperation between private enterprise and the military authorities will not be obtained promptly, and cheaply.

First of all among these current differences there seems to be the question of education of Congressmen. A vast majority of the legislators are unquestionably not interested in details. They would vote for anything which they honestly believed to be preparedness, if it would not cost altogether too much. But thus far, it appears, most of their education on these questions comes from narrowly interested folks from "back home." In almost every instance this type of education is anything but disinterested. It usually relates to a project for exploitation of something or other in the Congressman's district or the Senator's State. Independence of judgment among legislators is thus made somewhat difficult to secure.

The second major problem remaining appears to be a determination of the ways in which there may most effectively be developed cooperation between industry which holds its own stockpiles and the military agencies. If private

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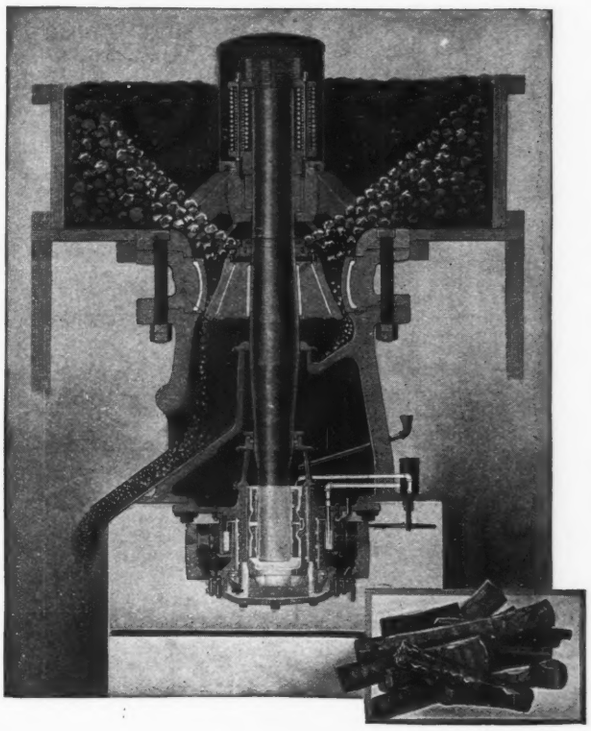

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industry would do in all cases what some units have done, there would be no need for stockpiling. Here are the contrasts—

A high Government official has announced that private industry, without any charge to the government or any indirect subsidy, has brought into the United States, at its own expense, stockpiles costing many millions of dollars. A high official announced this lately with respect to two mineral commodities which are on the strategic materials list. And he hinted at the fact that one or two other materials were in almost as good a position. In one case a three-year normal supply is now in reserve as a result of this forehanded plan of business.

In striking contrast is the situation with respect to tin, of which only a few months' supply is ever carried by private enterprise, and the Government has little.

Just how these problems will be solved by the Army and Navy folks, assisted by civilian mineral economists, remains to be seen.

Wages and Hours in Mining

PROBLEMS have been many in the mining industry when applying the Fair Labor Standards Act. They have even caused debate in the Senate. The American Mining Congress recently received an informative letter from a deputy administrator of the United States Department of Labor, Wages and Hours Division, from which the following is excerpted:

"There is nothing in the Fair Labor Standards Act which prohibits or interferes with the continuous operation of a plant. Neither is there a prohibition against working employees more than 44 hours in any workweek. There is only a requirement that time and one-half be paid for hours worked thereafter. Also, there is no limitation on the number of hours that may be worked in any day. For aught that is in this act, an employee may be worked 24 hours in a day without being paid overtime, assuming that he has not worked more than 44 hours in a particular workweek. Further, there is no requirement that the 44 hours be averaged or spread over the entire week. Thus it is possible in a given workweek to employ a worker 12 hours a day for 3 days and 2 hours a day for 4 days without payment of overtime. The Act contemplates the establishment of a workweek but different workweeks may be used for different workmen. For example, a mine operator may work 4 shifts a day in a continuous operation, each shift working 6 hours for a 7-day period. Under such an arrangement each workman would be employed 42 hours and entitled to no overtime.

"The flexibility of the act to meet the demands of continuous operation is easily demonstrated. For example: the workweek may be fixed so that an employee may work 11 consecutive days of 8 hours each followed by a 3-day layoff. This may be illustrated as follows: the workweek of employee B is fixed so as to commence at 12 o'clock noon on Saturday and end at the same time the following Saturday. B's working hours are from 8 o'clock a.m. to 4:30 p.m. with a half-hour lunch period between 12 o'clock and 12:30 p.m. He works on Monday, Tuesday, Wednesday, Thursday, Friday and Saturday morning of one workweek and Saturday afternoon, Sunday, Monday, Tuesday, Wednesday and Thursday of the following workweek. He then lays off Friday, Saturday and Sunday and resumes the same schedule on the following Monday. The only limitation on this plan is that the workweek cannot be changed unless the change is intended to be permanent. In the same manner, a mine operator, by beginning the workweek for different employees or groups of employees at different times and thereby working one group of employees while another group is off, may operate continuously 21 hours a day (if he establishes three 7-hour shifts) or 24 hours a day (if he establishes three 8-hour shifts) without being required to pay any overtime compensation."

Canadian Relations

MILITARY PLANS contemplate no dependence on Canadian cooperation. This seemingly weird fact is defended in this fashion: The United States might be involved in a military emergency in which Britain and Canada would be neutral. Then the United States might have to pay very dearly, or might be cut off under neutrality rulings from Canadian supplies of minerals. That is the philosophy by which aluminum and nickel are kept on the strategic materials list.

A somewhat more realistic explanation is that Uncle Sam could not afford to put himself in the position of paying war-time prices even to a friendly neighbor like Canada, without having any reserves within the boundaries of the States. Mere existence of limited military reserves in this country would preclude profiteering.

And finally there are the international political considerations of the State Department, hard to define, but probably more potent than any other form of reasoning. Commercial considerations are secondary.

Mineral Monopolies

DURING early February the investigations of the Temporary National Economic Committee have dealt with insurance problems. Later in the month some of the mineral industries will be on the grill. But the early February studies are also of significance for every kind of mining enterprise, and perhaps are more important to this industry than to the insurance man. Here's why:

Big insurance companies with tremendous investment power have been doing two or three things which the New Deal does not like. Perhaps most objectionable to the reform element of Washington has been the insurance companies' buying of whole issues of industrial securities after private negotiation. This bypasses S.E.C. It prevents the Federal investigators from getting all of the intimate business details which commercial marketing of the same stocks, bonds, or debentures would have made necessary.

In the second place, insurance companies have offended the modernists of Washington because of the tremendous leverage they might exert on any individual security they may own. They undoubtedly have the power to manipulate the security markets by the sheer force of their buying and selling movements. That they have not exerted this power improperly does not make them any less the target of criticism.

Mining executives who would like to market their securities privately and deal with insurance companies on a large scale may find opportunities curtailed as a result of present Washington thinking.

The schedule of mid-February calls for a series of mineral industry appearances before TNEC, about the time this issue of *E.&M.J.* should reach its readers. Most of the presentation will be by industries following studies of the Federal Trade Commission. The early listings place the following industries in unenviable preferred position: gypsum, sulphur, petroleum, steel, and natural gas. But the list is not complete, and others will come later, if they are not heard soon. All monopolistic aspects of these industries will be considered, as were the problems of the glass-container industry, which pioneered uncomfortably on the TNEC schedule.

News "Fines"

Money Manoeuvers — Apparently a "trade" is being agreed upon between the White House and the Senate. The President wants a continuance of the authority to adjust the gold value of the dollar, and to use the stabilization fund for control of international exchange conditions. The Western Senators are not particularly keen on supporting that Presidential authority, though they admit that the Chief Executive must have a good deal of freedom in the course of international negotiations these days. But they *very* much want a continuance of the silver purchase by Uncle Sam at not less than the present 64c. It is likely, therefore, that the President will get his gold authority, and the Senators will get their silver bonus.

The Silver Target—There is growing emphasis in Washington on the uneconomic and ineffective features of the silver purchase plan. A considerable number of Mid-continent and Eastern legislators would like to plug this leak in the Treasury because they think that it is no more than an outright bonus to Western mining, which, they say, does little good. There is growing evidence that silver is one of the most shining targets for those disposed to favor governmental economy. Nevertheless, the silver price is likely to be continued above the world market for some time, as explained in the preceding paragraph.

Minors as Miners—In the general regulations of the Children's Bureau, under the Wage-Hour Act, a new section of the rules practically precludes any employment of minors between fourteen and sixteen years of age in any mining occupation including any work "requiring the performance of any duties in work rooms or work places where goods are produced."

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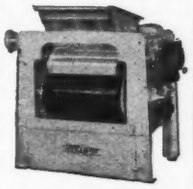

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HIGH STEARNS DUTY

A Revised NLRB—Since the American Federation of Labor has proved much more potent at the polls in the last six months than has CIO, there is every reason to expect that a radical revision of the National Labor Relations Act will occur. The clean-cut proposals of A. F. of L. are the basis of the Walsh bill (S. 1000). At this early stage it appears likely that revisions will come nearer to this set of proposals than to any other, though business spokesmen generally want a lot more, and CIO will be militant against even this much change.

Congress Power Defined—Twice on Jan. 30 the Supreme Court made clear its concept of the very great powers of Congress to regulate business enterprise. In the TVA decision it announced that public utilities of the Valley area have no grant of a monopoly which would preclude Congress from setting up competing activities, if it so chose. In supporting the National Bituminous Coal Commission, the Court on the same day stated: "Obviously publication may be harmful to petitioners, but as Congress had adequate power to authorize it . . . we can find here no sufficient basis for an injunction." These two cases, and other recent actions of the Court, seem to mean that Congress may have the right to destroy private enterprise, if it so chooses, within its authority to regulate interstate commerce in the public interest. Those who note this sweeping interpretation as possible, express the hope that Congress will exercise it with discretion.

TVA May Proceed, But . . .—In the Supreme Court ruling which gave no relief to public utilities seeking to prevent further TVA competition, the Supreme Court gave a clear "go" signal to the Valley Authority. Using that authority, TVA quickly closed a deal for purchase of Tennessee Electric Power facilities. But—and this is very important—the House has very sharply curtailed proposed spending for new hydro-electric dams next year.

Strategic Materials Bill—The Military Affairs Committee of the Senate on Feb. 24 reported favorably on the bill introduced by Senator Thomas authorizing the expenditure of $102,000,000 over a period of four years for the acquisition of stocks of raw materials needed for the manufacture of supplies for the armed forces and the civilian population in time of national emergency.

American Mining Congress To Meet In Utah

▶ Salt Lake City, Utah, has been chosen for the Sixth Annual Metal Mining Convention and Exposition, Western Division, American Mining Congress, from August 28 to 31, 1939. Each year these annual industry conventions have attracted nation-wide interest, and attendance at the meetings has registered a steady increase. At Los Angeles, in October, 1938, over 2,000 mining men attended, and it is expected that this record attendance will be surpassed when the industry meets in Salt Lake City in August.

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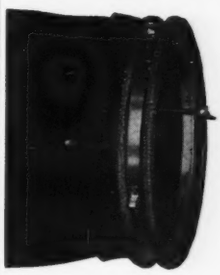

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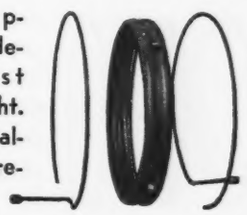

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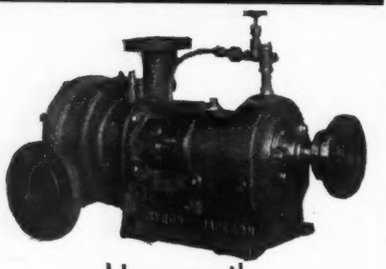

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New Mining and Milling Technique Discussed at A.I.M.E. Meeting

Problems of industry well covered—Tom Girdler, Admiral Woodward and Herbert Hoover address members—Donald P. Gillies inducted president for 1939—Louis S. Cates awarded Williams Lawrence Saunders Medal

MEMBERS of the American Institute of Mining and Metallurgical Engineers who attended the 150th meeting in New York City, Feb. 13-16, found diversified subjects of interest in the non-ferrous metal-mining industry ably presented and discussed. Attendance at the convention was comparable to last year's meeting, and delegates from various mining districts of the country generally believed the outlook for metal mining held promise for steady improvement during the remainder of the year.

Mining methods discussed at the first day's sessions included data collected in a study by David Sinclair and Philip B. Bucky, of Columbia University, presented in the paper entitled "Photoelasticity as Applicable to Mine Pillar Problems." Modern trends in quarry blasting were discussed by J. Berab, of the Kelbar Powder Company. Papers on mill practise at the first day's sessions included one presented by E. W. Engelmann on the history of milling developments of the Utah Copper Company.

The All-Institute meeting on Monday afternoon had for its speakers Tom M. Girdler, president of the Republic Steel Corporation, and Rear Admiral Clark Woodward, Member General Board United States Navy, who addressed members on "Some Economic Problems of the Mineral Industry" and "Industry's Relation to National Defense," respectively. Mr. Girdler said that the United States was either wholly or partially dependent on foreign supplies for seven of the twelve non-ferrous metals used in the steel industry and suggested that a two-year supply of these deficient minerals be accumulated. "All these materials are essential to the modern steel industry. In peace or war it is imperative that they be available in adequate supply. I am impressed by the logic of the proposal for government acquired reserves of at least two years' needs."

Admiral Woodward in his address on national defense said: "We are not embarking in a mad scramble for naval supremacy, or even encouraging an international armaments race, as is so blatantly claimed by pacifists and anti-preparedness zealots. America has planned her Navy for the defense of the nation, and America must not forget that the Navy stands or falls by its strength at the time war breaks."

Tuesday's sessions on mining were devoted to a paper on "Sand Filling of Stopes at the Homestake Mine," by A. J. M. Ross and presented by Guy M. Bjorge, general manager of the Homestake Mining Company. Papers entitled "Block Caving at the Iron Ore Mines of the Colorado Fuel & Iron Company" and "Development of Scraper Loading in the Tri-State District" were presented by George H. Rupp and S. S. Clarke respectively. In another session devoted to milling, Harlowe Hardinge, of the Hardinge Company, described the new "electric ear," a device for automatically controlling the operation of grinding mills by their sound. (See page 84). Comparative pulp washing efficiencies between compartment type thickeners and unit type thickeners was discussed by Neil O. Johnson, of the Dorr Company. Frank R. Millikin, of the General Engineering Company, pointed out factors for the determination of an economic milling rate in his paper. The use of a halogenated hydrocarbon "parting liquid" in the sink-and-float process was discussed by W. B. Foulke, of E. I. du Pont de Nemours & Company.

Rock penetration was the general subject of discussion on Wednesday. J. B. Newsom, Idaho Maryland Mines Corporation, discussed the Zenith mine bore hole at Ely, Minn. J. B. Martin, of the Sullivan Machinery Company, described methods in drilling the world's deepest core-drill hole. Papers on the much-discussed subject of detachable bits and their design were presented by W. M. Ross, of the Ingersoll-Rand Company, and by Lucien Eaton, of the Isle Royale Copper Company. Recent developments in drilling large blast holes were discussed by L. B. Birckhead, of the Bucyrus-Erie Company. T. G. Chapman presented an interesting paper on gold recovery from low-grade gold ores in a cyanide process based on simultaneous dissolution and absorption of gold. Papers on health and safety in mines, geophysical methods of exploration, non-ferrous metallurgy and subjects of particular interest to the coal industry and the iron and steel industry rounded out the technical sessions of the convention.

At the annual banquet and reception held at the Waldorf-Astoria, president D. C. Jackling presented the William Lawrence Saunders medal to Louis S. Cates, president of Phelps Dodge Corporation, for accomplishment in the conception and application of superior mining technique. The Robert Woolston Hunt award was presented to Professor John Chipman, of M.I.T., and Kenneth C. McCutcheon, of the American Rolling Mill Company, for their paper on "Evolution of Gases from Running Steel Ingots." The Institute of Metals Division Award was presented to Professor Frederick N. Rhines and Robert F. Mehl, both of Carnegie Institute of Technology, for their paper, "Rates of Diffusion in Alpha Solid Solutions of Copper." The Alfred Noble prize, presented to a member under 31 years old, was awarded to Ralph J. Schilthuis, of the Humble Oil & Refining Company,

Houston, Tex., for his paper on "Connate Water in Oil and Gas Sands." Daniel C. Jackling, outgoing president, presided and Donald B. Gillies, vice president of the Republic Steel Corporation, was inducted as president for 1939.

Former President Hoover was present and he appealed to the members to give young men an opportunity to get a job when they graduate. "They should be given the opportunity to enter the profession at least at manual labor. A large majority in this room entered the profession through their hands rather than their heads, and I don't believe any of us found it a great hardship but rather an enormous advantage."

TRI-STATE

Several Mines Curtail Production Schedules

Low prices for zinc continue to exert pressure and some properties are forced to close

▶ Zinc concentrates production was maintained at 7,500 tons per week during February in the Tri-State area. Shipments averaged at about the same figure, so that stocks of concentrates in mill bins stayed between 11,000 and 12,000 tons. The Commerce Mining & Royalty Company shipped its large reserve stock of lead concentrates during January and February, and as a result stocks of lead concentrates in mill bins were reduced to less than 1,000 tons. The Commerce Mining & Royalty Company suspended operations at the John Beaver No. 1 mine early in February. The night shift has also been suspended at the Blue Goose mine and the mill cut to a single-shift operation. S. S. Clarke is general mine superintendent.

▶ Mining operations were discontinued at the north shaft on the Crystal lease of the Eagle-Picher Mining & Smelting Company, west of Cardin, late in January. About 35 men were affected, according to R. J. Stroup, chief engineer.

▶ The Evans-Wallower Zinc, Inc., has suspended ground operations at its No. 4 mine, which has been contracted to Cameron & Henderson, Inc. Ore from No. 4 and No. 9 mines, which also is being mined by Cameron & Henderson, will be milled by Evans-Wallower Zinc, Inc., at its No. 4 mill. The Evans-Wallower company is reconditioning its No. 7 mill, north of Cardin, Okla., and will start mining operations on the 200-ft. level at this mine as soon as the mill is ready. Floyd Gooch is district manager.

▶ The Aurora Mining & Development Company has leased more than 1,000 acres in the old Aurora, Mo., mining camp about one mile northeast of the town. An extensive drilling campaign is to be undertaken to prospect deeper levels in territory that had not previously been developed. Aurora was an active mining camp from 1893 to 1913, and is credited with a production of more than 300,000 tons of zinc concentrates and 4,000 tons of zinc silicate from shallow workings. Spasmodic attempts have been made to develop ore at deeper levels within the proved area during the intervening years. Larry Brunk is manager.

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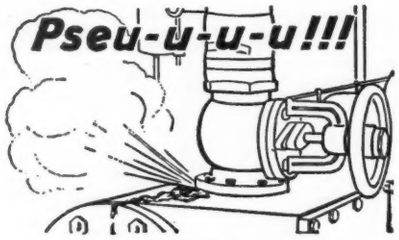

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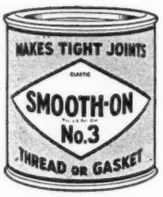

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MICHIGAN

Miners Wish Excise Copper Tax Continued

Michigan operators will try to prevail on their Congressmen to have 4c. tariff on copper imports retained

▶ A concerted movement is under way in the Michigan copper district to prevail upon Congress to continue the present 4c. excise tax on copper, which will expire by limitation in June of this year. Congress will be petitioned to take such action as will extend the tax and, if possible, add another cent to it. It will be pointed out that the original reason for the tax still exists, and that the miners of copper in the United States find it difficult to continue to employ labor, even with the help afforded by the tax. Re-enactment of the tax is declared to be imperative, for further adverse conditions might force the mines to close. It is the desire to protect American mine workers in their jobs, to keep them off relief rolls, and to insure for the Government an adequate supply of always available copper that prompts the movement to extend the present excise tax on the metal.

CANADA

British Columbia Will Encourage Prospecting

A mining school will be established and plans are being studied to finance prospectors — Hollinger Consolidated Gold Mines again is the Dominion's leading gold producer — McIntyre Porcupine has new ore developments

▶ The decline in prospecting in British Columbia is the subject of growing concern, as it is more widely realized that the discovery of new mines is not keeping pace with increasing production. The need apparently is for trained men with financial backing to explore the more remote mineral areas and to prospect more intensively the old mining regions. The Provincial Government is prepared to meet the first deficiency by establishing a regular school for training selected young men in modern and systematic methods of prospecting. The necessity for financing exploration ventures has been placed squarely before the mining industry itself by Dr. J. F. Walker, Deputy Minister of Mines. He expresses the view that the day has come when the industry must support the prospector either by giving him employment in the winter months and releasing him during the summer, or by employing him during the summer at a wage that will provide him with a grubstake for the winter.

▶ A new placer camp was proved last summer by successful operations in the Boulder Creek area, Atlin. Clean-ups were made at three properties on the Creek, one of which yielded $40,000 in a short "run," and five other leases were prepared for production next season. Percy Peacock has sold his ground to the Barrington-Walsh interests, of Seattle, and it is reported they plan to install a dragline plant in the spring.

▶ Smaller operations in the Portland Canal district have been curtailed for the severe winter, although the larger mines are proceeding without interruption.

▶ Reward Mining Company's new mill at Porcher Island is treating 40 tons of ore a day, and it is planned to increase the rate to 65 tons by the addition of adequate machinery. A. M. Richmond, consulting engineer, estimates that a net profit of $13,400 a month is indicated for a 65-ton milling operation.

▶ Privateer Mines, Ltd., Zeballos, has acquired the Van Isle group of twenty claims and fractions adjoining its original group on the south. This doubles its property and covers the possible extension of the main vein. The Van Isle is equipped with a complete mining camp, and several veins have been discovered

▶ The downward continuation of the orebody at Rey Oro mine, Zeballos, is being opened successfully at the second level, 50 ft. below the main adit. Edward G. Brown is president.

▶ Other operators in the Zeballos camp are preparing to redouble development work in the spring. Power plants are being installed at several properties, including the Golden Peak No. 4 group of Dentonia Mines, and the White Star mine.

▶ Recent development work at Hedley Mascot has been successful in adding substantially to probable and prospective reserves, according to the secretary, V. J. Creeden, of Vancouver. The consulting geologist, Dr. Victor Dolmage, reports that an important deposit has been found by diamond drilling through a section of No. 4 orebody, and reserves in Nos. 3 and 5 orebodies have been increased.

Ontario

▶ Hollinger Consolidated Gold Mines last year recaptured the lead from other Canadian gold producers after losing out to Lake Sore Mines in 1930. Bullion recovered in 1938 was valued at $15,496,804, which was substantially above all other years except 1925. Earnings exceeded all years since 1934, ore reserves increased almost three million dollars, to 7,506,750 tons, valued at $86,972,640, and net working capital was strengthened to $7,238,702. John Knox, general manager, states that the new No. 26 shaft has been completed to the 2,450-ft. level. The president, Jules R. Timmins, points out that taxes charged against 1938 operations amounted to 61.6c. per ton milled, and that milling charges were reduced to 63.76c. per ton. The new primary grinding plant has exceeded estimates in cost reduction and the transfer of concentrate grinding to the new plant is being considered.

▶ Important ore developments are reported from the McIntyre Porcupine mine, where the new 25 vein to the north

is undergoing exploration on the 3,750 level. With the face still in ore, the drift has opened 360 ft. with an average gold content of 1 oz. per ton. On the level below, an ore section 730 ft. in length has been exposed, the width averaging 16 ft. On the 3,750 horizon vein widths exceed 10 ft. at this stage, carrying from 5 ft. to 25 ft. where it has been slashed. Crosscuts 600 ft. long are being driven from the No. 11 shaft on the 3,625 and 4,125 levels. Deeper exploration will be directed from the No. 12 internal shaft, 2,000 ft. south of No. 11.

▶ J. Gordon Hardy, president of Falconbridge Nickel Mines, reports that refined metals were produced last year in excess of the output for 1937, 27 per cent in nickel and 32 per cent in copper. The program this year calls for opening new ground between the two shafts to a depth of 1,200 ft. In September a new plant for the recovery of liquid sulphur dioxide was put in operation. Underground development was carried to the 2,100-ft. level. E. Craig is manager.

▶ The new 300-ton mill at Preston East Dome is scheduled to go into production before the end of February. The mill is a standard cyanide unit, although space has been provided to install flotation equipment if that is found to be necessary.

Quebec

▶ The annual report of Lamaque Gold Mines reveals one of Canada's most notable records of mine expansion. As compared with the preceding year, 1938 figures for tonnage milled show a 70 per cent increase; reserve tonnage was up 12 per cent; earned surplus up 61 per cent, and working capital up 53 per cent. Out of $4,565,264 gross revenue Lamaque took a net profit of $1,658,511. Mill recovery for the year averaged $11.59 a ton, with total costs (except taxes) $6.58 a ton, compared with $8.88 a ton in 1937. Positive ore reserves have been increased to 742,236 tons, valued at $8,307,329.

▶ Lapa Cadillac Gold Mines has improved net profits through the addition of cyanide treatment, with an ultimate mill capacity of 300 tons a day. Shaft sinking has been completed to 690 ft., where a new level has been established. The president, Dennison Denny, announces that development will be extended into interesting ground to the east, where diamond drilling has not yet been attempted.

▶ Plans are being made for continuing westward into Quebec with the large-scale exploratory work that has been carried on for the last three years by the Labrador Mining & Exploration Company. The Quebec Bureau of Mines has granted a mining concession of 3,500 square miles in the interest of McKay (Quebec) Exploration, Ltd., which directs the Labrador program, for a two-year period with renewal privileges. The 20,000 square miles in the Labrador interior, where mapping and prospecting have been in progress for the last three years, lie about 425 miles east of the Chibougamau mining district of Quebec. The intervening territory is largely unknown.

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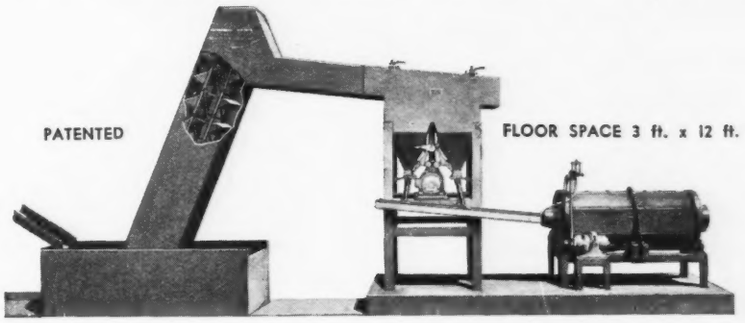

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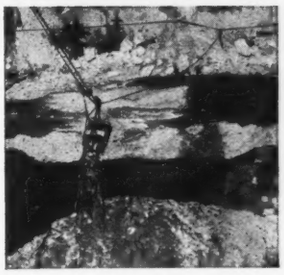
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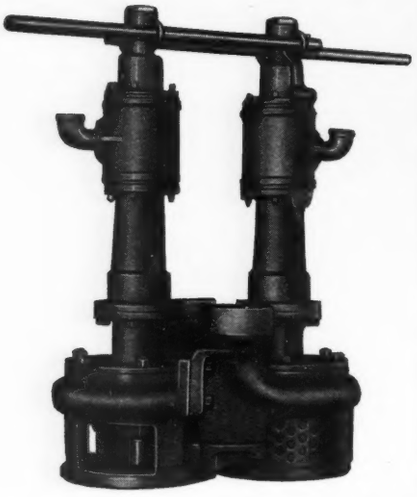

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In Managua, Nicaragua, this aerial view looks down on the buildings and foundation holes for the site of a new 600-ton mill unit of the La Luz Mines, Ltd., where operations will commence later this year and be gradually increased to accommodate a daily production of 1,200 tons some time in 1940

MEXICO

Labor Board Seeks to Settle Major Strike

Meetings in Mexico City of government officials and representatives of American Smelting & Refining Company strive to end long dispute at Monterrey refinery—A.S.&R. smelter at Avalos threatened with strike during peace negotiations

▶ Mining in Mexico attained a new slowness with the end of winter. Operations virtually marked time. There was some apprehension as to what will happen when silver purchases by the American Government end on June 30. Labor troubles obtained, though they were not particularly acute. As a result of the interview representatives of the national miners' union had with him, President Lazaro Cardenas called a meeting for Mexico City of delegates of the union and the American Smelting & Refining Company with a view to ending the strike that has kept closed since late in November the company's refinery at Monterrey, Nuevo Leon. This meeting is to be held as soon as representatives of both sides can assemble. It is expected for late in February. On Feb. 23 the American Smelting & Refining Company received a surprise notice that a strike would be called March 7 at its Avalos Smelter at Chihuahua. The Labor Board will seek to effect a settlement before this date if possible.

▶ Daylight saving, advancing time an hour, was ordered by the Federal Government for the Federal District and Hidalgo, Puebla, and the State of Mexico, as a measure to conserve electricity, as supply was running low because of a paucity of water for the generating plants of this sector, causing some disturbance in the mining industry of the belt. The industry had to find means for curtailing its workday by two hours. That prompted a dispute as to whether the companies should pay for a full work day.

▶ Test cases have been filed in Mexico City courts by mining companies to determine the validity of the Federal law, enacted Dec. 27, which allows prospectors and other small miners' cooperative societies privileges in the form of exemption from taxes.

▶ Prospectors and small-scale miners of the Guanajuato City sector, Guanajuato, have induced the Ministry of National Economy to establish free assay service for them in Guanajuato. They maintain that private assaying is expensive and unreliable.

▶ The National Railways of Mexico announces cancellation of franking privileges for car movements and telegraph services that were long held by American Smelting & Refining and Cia. Minera de Peñoles. Salvador J. Romero, general manager of the Railways, announced that his company's difficult economic condition is largely due to low preferential freight rates allowed the mining industry, competition from highway services, and debts accumulated by other administrations of the railroad, which is now being run by its employees.

▶ A mining school has been established in Mexico City by the national miners' union with aid of the Federal Government.

▶ Cia. Minera El Año Nuevo, El Arco, northern Lower California, has been granted Federal authorization to suspend work for an indefinite period because operations are unprofitable.

▶ The Federal Supreme Court recently made two interesting labor rulings: Companies must first reject employees' demands before a strike can be called; agreements made between employers and workers for the settlement of disputes must be reviewed and approved by the Federal Labor Department.

▶ Labor trouble has developed for Cia Industrial Minera de Maguarichic, Chihuahua, because it refused to increase its workers' daily salary by 50 centavos

(about 10c.) inasmuch as it only recently gave employees a raise of 25 centavos a day.

▶ Several actions in Mexico City district courts have been brought by mining companies, among them Cia. Minera Santa Maria de La Paz y Anexas, S.A., Villa de la Paz, San Luis Potosi, to upset the Federal law enacted last Dec. 27, which exempts from taxes cooperative societies of prospectors. The object of the law is to encourage the establishment of such societies. The companies say that the law prejudices their interests as it allows the cooperatives such privileges that they will be able to compete with them, a circumstance that will not be to the firms' advantage.

AUSTRALIA

North Kalgoorlie May Erect New Mill

Ore mined from developed Croesus mine will be treated in proposed new plant—Big Bell Mines, Ltd., options the Mars mine—Ore exhaustion closes Bolwarrah mine of Gordon Gold, N. L.

▶ Although complete official returns are not yet available, figures so far to hand indicate that the Australian gold yield for the year 1938 was approximately 1,588,000 oz., compared with 1,380,431 oz. in 1931. Details are:

	1937 Fine Oz.	1938 Fine Oz.	Inc. or Dec.
Western Australia	1,000,647	1,167,792	+167,145
Queensland	125,748	149,671	+23,823
Victoria	145,799	144,253	—1,555
New South Wales	68,607	88,708	+20,101
Other	39,630	38,000	—1,630
Totals	1,380,431	1,588,424	+207,993

Principal factors affecting production were:

Western Australia—First full year's operation of Big Bell; starting of other smaller producers; and general expansion of operations at many mines.

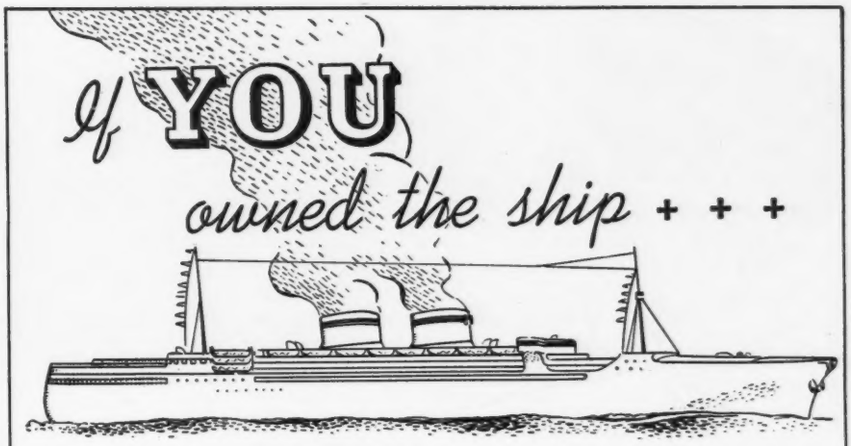
Queensland—Expansion of operations at Mount Morgan mine.

Victoria—Drought retarded alluvial and other operations.

New South Wales—Starting of Wellington dredge; augmented operations at Cobar.

Western Australia

▶ Ore reserves of Paringa Mining & Exploration Company, Ltd., Kalgoorlie, totaled 258,149 long tons, assaying 5.66 dwt., as at Aug. 31 last, showing an increase of 38,000 tons compared with the previous year. The mill, which went into operation in May, is now treating 5,500 tons monthly, but as mine development has advanced to the point of being able to supply 7,000 tons monthly, mill capacity is being increased accordingly. Further increases are planned for a later date. T. W. Greenhill is mine manager. It is reported from Kalgoorlie that North Kalgurli (1912) Ltd., which is at present milling 11,000 tons monthly at the plant of Kalgurli Ore Treatment Company, Ltd. (jointly owned by North Kalgurli and by Boulder Perseverance,



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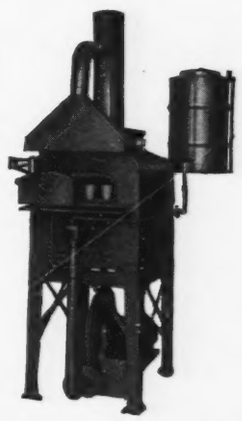

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One of Australia's new mills is that of the Paringa Mining & Exploration Company, Ltd., where capacity is 5,000 tons monthly. Flotation, roasting of concentrate, and cyanidation of the calcine are employed in recovering the gold

▶AUSTRALIA

Ltd.), is likely to erect a mill of a capacity of 6,000 tons monthly on the Croesus group of leases, the northern part of the company's property. Ore for the new mill will, it is believed, be taken from the Croesus group, which have hitherto turned out only 1,000 tons monthly, so that the operation of the new plant would mean about a 50 per cent increase in the production of the company.

▶ Big Bell Mines, Ltd., which turned out about 70,000 oz. of gold in 1938 from its property near Cue, has taken an option over the Mars mine, at Boogardie, on the Murchison gold field. The Mars contains a large ironstone lode which has yielded on trial crushings at the rate of 5 dwt. per ton.

▶ Lancefield (W.A.) Gold Mine, N.L., which has been under somewhat of a cloud in recent months, has struck the lode in the bottom level (No. 15) of its mine at Beria. Where cut, the lode had a width of 24 ft. and assayed 6 dwt. per short ton. Driving north and south has been extended a total length of 56 ft., values averaging 7 dwt.

Victoria

▶ Gordon Gold, N.L., whose mine at Bolwarrah had the extraordinary record of having returned £107,000 Australian in dividends in a space of 3½ years on a paid-up capital of £7,030 Australian, has ceased mining operations owing to exhaustion of ore reserves, but is investigating two other properties in the neighborhood with a view of developing another producing mine. Meanwhile, the treatment of accumulated residues will be undertaken during the next year or two.

Queensland

▶ No. 1 dredge of Tableland Tin, N.L., had its trial runs recently and is now entering on commercial production. The machine, a reconstructed unit of 100,000-cu.yd. monthly capacity, is expected to recover 40 tons of tin oxide monthly. The company has under construction a second dredge of 350,000-cu.yd. monthly capacity. Development of a large alluvial tin area in the district is anticipated, as, in addition to the Tableland Tin area on which 80,000,000 cu.yd. of ground averaging 0.5 lb. tin oxide per cubic yard have been proved, the Broken Hill Proprietary Company is boring an area at Battle Creek, 7 miles away, which is expected to develop satisfactorily.

Tasmania

▶ Development of a large copper mine in the West Coast district of Tasmania is foreshadowed by the formation of a syndicate to explore an area of virgin bush land at Nicholl's Range. Preliminary sampling has given encouraging results, and £25,000 has been put up to test the area. If successful, it is reported that not less than £300,000 of English capital will be forthcoming for further development.

AFRICA

Good Ore Continues In Gold Coast

Recent developments enhance prospects for many years of production—Drilling in Orange Free State holds up well—Marlu Gold Mining Areas will increase plant capacity

▶ Further confirmation of the belief that the Gold Coast will be the scene of great development activities during the coming few years at least is afforded by recent developments. For instance, Ashanti Goldfields has opened what it calls "The Reef" on the 30th level, the crosscut showing an average of 77.6 dwt. per ton over a width of 18 ft. The exploratory work on the Siwum property of Kwahu Mining has resulted in opening for a length of 151 ft. on the 250-ft. level of a reef averaging 28 dwt. over an average width of 41 in., this after reducing the exceptionally high values. Good ore is being encountered quite generally in development work throughout the district and all of the

producers are reporting excellent and usually increasing earnings.

▶ Marlu Gold Mining Areas has ordered the equipment for the increase of plant capacity to 75,000 tons a month. This company has agreed to join in the scheme mentioned previously to examine and develop the main line of the crush zone for a distance of three miles.

▶ South Banket Areas proposes to raise new capital for the erection of a plant of 15,000 tons per month capacity. This is recommended by its consulting engineer, A. Michael Robinson, who has just reported that ore reserves are now 622,300 tons averaging 5.65 dwt. over average widths of 42.4 in. He states that a borehole at a point 2,900 ft. "west of the outcrop in the dip of the reef" has cut two reefs, the first of which showed only 10 grains and the second 9.4 dwt. over 23 ft., 5 ft. of which averaged 41.6 dwt. per ton, the core showing visible gold. Robert Sweeney is chairman of this company.

▶ Union Minière du Haut-Katanga earnings for 1938 are understood to have been sufficient to permit of the dividend being maintained at the 1937 rate without drawing on the dividend stabilization fund. The company has brought its new Ruwe mine into production in the western Katanga. It is reported also to have reached a quota output of radium agreement with Eldorado Mines of Canada.

▶ The British Government is reported to be making a census of copper supplies in British warehouses and manufacturers' stocks, the object being to ascertain the amount which would be available in the event of a national emergency. It is considered possible that the Government may soon decide to acquire a considerable stock of the metal on its own account.

▶ Another good report is that by Western Holdings, the company in which Selection Trust and several other prominent finance companies are largely interested, which is drilling an extensive area in the Orange Free State in expectation of proving an extension of the Witwatersrand reefs into that region. Borehole St. Helena No. 5 has cut 20 inches of conglomerate at a depth of 1,533 feet which assays 7.4 dwts. of gold to the ton over a true width of 18.5 inches. This hole is about a mile east from St. Helena No. 1, in which good values were cut at a depth of 2,751 feet, as long ago as last July. It is suggested that this latest strike may be in a reef belonging to the Upper Witwatersrand series known as the Elsburg, which in some of the mines is important. Drilling is continuing.

▶ Most of the operating mines on the Witwatersrand are reporting increases in ore reserves. In some properties, but by no means in all, the average grade is a shade lower. It is more or less generally believed that the long-continuing decreases in the average of the grade milled will soon cease, about the present average being maintained hereafter. Production of the district now seems to be established above 1,000,000 oz. a month, and the outlook is favorable to a continuing increase.

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NEW BOOKS

CANADIAN MINES HANDBOOK. *Northern Miner Press, Ltd., Toronto, Canada. Pp. 416. Price $1.*

LISTING and describing the Canadian mining organizations that were active in 1938, this 1939 edition of the handbook continues the excellent service and standard set by its predecessors. The book contains also a separate list of inactive companies that were, for one reason or another, not qualified for review in the active list. Finally, there is a list of companies that have either passed out of corporate existence or about which no information is available. The total list comprises 5,526 companies, of which 1,404 were active.

THE STONE INDUSTRIES. *By Oliver Bowles. McGraw-Hill Book Company, Inc., New York and London. Pp. 519. Price $5.*

IN PUBLISHING the second edition of this volume the author has brought its contents up to date—January, 1939—particularly with respect to statistical tables. Little revision was necessary on centers of production, or on the technology of quarrying and fabrication. In short, the book portrays the stone industries as they exist today. The various chapters deal comprehensively with the geology, technology, distribution, and uses of dimension stone and crushed stone.

THE ENGINEERS' MANUAL. *By Ralph G. Hudson. John Wiley & Sons, Inc., New York. Chapman & Hall, Ltd., London. Pp. 340, 5x8 in., flexible cover. Price $2.75.*

DESIGNED for the practicing engineer as well as for the engineering student, this is the second edition of Professor Hudson's excellent handbook. It represents a consolidation of formulas and constants for which one must frequently search through several volumes. Chapters are devoted to mathematics, mechanics, hydraulics, heat, electricity, and mathematical tables. The chapter on heat and a large part of the chapter on electricity have been rewritten, and all parts of the book have been improved and brought up to date.

FORGING PRACTICE. *By C. H. Johnson. American Technical Society, Drexel Ave. at 58th St., Chicago. Pp. 136. Price $1.50.*

HERE is another of the publishers' "how-to-do-it" series. It is practical, simply written, and copiously illustrated. The author, a member of the faculty of Worcester Polytechnic Institute, is experienced both in the shop and as a teacher. Topics discussed, in their order, are: Workable metals, structure of iron and steel, cast-ingot steel, hot and cold working of metals, hand forging, welding by forging, tool forging, hammer forging, drop forging, bulldozers, upset forging, hydraulic forging presses, hot and cold rolling, roll piercing and forging, cold swaging, pressing and drawing, extrusion of metals, spinning of metals, defects in forging, heat-treatment of steel forgings, and identification of steel.

ORE DEPOSITS OF THE SAN CARLOS MOUNTAINS. *By Edson S. Bastin. Included in "The Geology and Biology of the San Carlos Mountains, Tamaulipas, Mexico." Reports of the University of Michigan Expedition to the San Carlos Mountains in 1930. Directed by Lewis Burnett Kellum. Volume XII of the University of Michigan Studies (Scientific Series), University of Michigan Press, Ann Arbor, Mich., 1937. Pp. 341. Price: $5.*

THE CHAPTER on "The Ore Deposits of the San Carlos Mountains" includes an excellent description of the geology of the San Jose copper deposits, located in the San Jose district, and the lead-silver deposits of San Nicolas, El Palmar, and Moctezuma districts. The copper deposits of the San Jose district, although classed as typical "contact metamorphic" deposits, are somewhat unusual in that they are found chiefly within an intrusive diorite porphyry laccolith associated with an alkaline igneous complex consisting largely of nephelite syenite and related rock types. The orebodies are found within the diorite porphyry at or near its contact with Cretaceous limestone and are believed to have formed within less than 2,000 ft. below the limestone roof overlying the diorite intrusive.

The usual assemblage of contact metamorphic minerals is present, with garnet and epidote predominating, and the more intense metamorphism has been accomplished within the diorite instead of in the limestone. Most of the orebodies are small, irregular, and erratic in distribution. Metallic minerals consist of pyrite, pyrrhotite, chalcopyrite, and magnetite, with minor molybdenite, galena, and specular hematite. The mineralizing solutions are believed to have had their source in the diorite and were guided largely by joints within this rock.

Detailed descriptions of twelve mines and prospects within the district are given. Economic mineralization does not extend to any great depth and most of the workings have long been abandoned.

The lead-silver replacement deposits of the San Nicolas, El Palmar, and Moctezuma districts are described. These occur in Cretaceous limestone and consist of nearly vertical fissure veins from 1 to 5 ft. in width. They contain chiefly silver-bearing galena in a gangue of calcite, siderite, barite, and quartz. The greatest depth to which any of the mines have been worked is 420 ft. Geologic indications are said to justify deeper exploration. A short account of the history of the district and the nature of the mineralization is given.

PHILIP KRIEGER

▼

PUBLICATIONS
RECEIVED

The Mica Industry. Report 130, Second Series. U. S. Tariff Commission. Pp. 155. For sale by Superintendent of Documents, Washington, D. C. Price 25c.

Phosphate-Rock Mining, 1880–1937 (Technology, Employment, and Output per Man). Prepared by A. Porter Haskell, Jr., and O. E. Kiessling, WPA National Research Project and U. S. Bureau of Mines. Pp. 130.

Denmark, Finland, Norway and Sweden; Mineral Production and Trade of. Foreign Minerals Quarterly. Issued by Economics and Statistics Branch, U. S. Bureau of Mines, Washington, D. C. Pp. 74.

Canada. Talc and Soapstone Industry (Including Nepheline Syenite) in Canada, 1937. Pp. 8. Price 10c. Also, *Report on Miscellaneous Metals in Canada, 1937.* Pp. 29. Both published by Dominion Bureau of Statistics, Ottawa, Canada.

Grinding, Conclusions From Experiments in. By W. H. Coghill and F. D. DeVaney. Bulletin, Missouri School of Mines and Metallurgy. Rolla, Mo. Pp. 102.

American Standard Safety Code for the Protection of Heads, Eyes, and Respiratory Organs. Handbook H24, National Bureau of Standards. For sale by Superintendent of Documents, Washington. Pp. 95. Price 15c.

Careers in the Mineral Industries. By T. T. Read, Columbia University. A vocational booklet for use in secondary schools. Published by A.I.M.E., 29 West 39th St., New York.

The Mica Industry in Canada, 1937. Also, the *Feldspar and Quartz Mining Industry in Canada, 1937.* Dominion Bureau of Statistics, Ottawa. Price, each, 10c.

The Rice Lake Gold Area, Southeastern Manitoba. By C. H. Stockwell. Memoir 210, pp. 79 and maps. Price 25c. Also, *Geology and Mineral Deposits of Freegold Mountain, Carmacks District, Yukon.* By J. R. Johnston, Memoir 214, pp. 21 plus map. Price 10c. Also, *Laberge Map Area, Yukon.* By H. S. Bostock and E. J. Lees. Memoir 217, pp. 32 and map. Price 25c. Published by Dominion Geological Survey, Ottawa.

Kenya Colony. Geological Survey of No. 2 Mining Area, Kavirondo. Interim report and map of southwest quadrant. By William Pulfrey. Report No. 7. Mining and Geological Department, Nairobi, Kenya Colony. Pp. 64 and map. Price 2s.

Geology of the Slana-Tok District, Alaska. By F. H. Moffitt, Bulletin 904, U. S. Geological Survey. For sale by Superintendent of Documents. Pp. 54, plus map. Price 35c.

Experiments in Geophysical Survey in New Zealand. By N. Modriniak and E. Marsden. Geological Memoir No. 4, Department of Scientific and Industrial Research, Wellington, N. Z. Pp. 92 and insert maps. Price 7s. 6d. Also the *Report of the Geological Survey Branch* of the aforesaid department, 1937-38. Pp. 22.

The Nushagak District, Alaska. By J .B. Mertie, Jr. Bulletin 903, U. S. Geological Survey. Pp. 96, with maps. Sold by Superintendent of Documents, Washington, D. C. Price 65c.

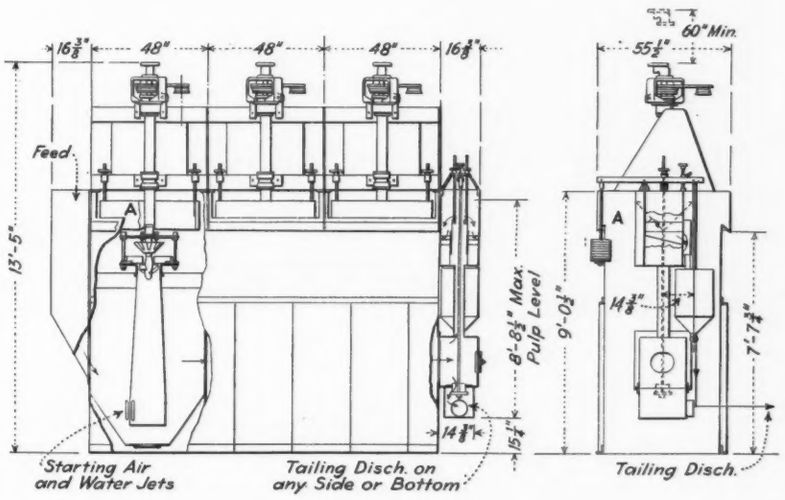
Improving the Properties of Clays and Shales. By J. G. Phillips. Bulletin 793, Dominion Bureau of Mines. Pp. 39. Price 25c.

Agenda Dunod, 1939. Three volumes, in French: "Mines," by Eugene Stalinsky. Pp. 279, plus appendix of tables. "Construction Mécanique," by J. Izart. Pp. 356, plus tables. "Metallurgie," by R. Cazaud. Pp. 326, plus tables. Published by Dunod, 92 rue Bonaparte (VI), Paris. Price 25 fr. each.

EQUIPMENT NEWS

Multi-Stage Flotation Machine

SAID TO REPRESENT the first attempt to combine rationally the several mechanical elements of a flotation machine so that each performs its particular function only to a useful purpose and at the right time and place, the Pan-American Engineering Company, 820 Parker St., Berkeley, Calif., introduces its Pan-American Multi-Stage flotation machine for treating precious- and base-metal ores, for small- or large-scale mining operations. Agitation, aëration, and circulation of the pulp in the Pan-American Multi-Stage flotation machine is said to be obtained to the best mechanical and metallurgical advantage owing to special design of the unit, whose weight is low owing to all welded steel plate construction of tank and rotor supports.



The pulp is introduced to the machine through a feed box, and enters the cell near the bottom in a zone where all the incoming pulp tends to be drawn to the intake tube. Owing to the construction of the bottom of the cell—an inverted frustum of a cone—the cross-sectional area of the tank near its bottom decreases rapidly with depth and the velocity of the pulp consequently increases with depth sufficiently to prevent any sanding up taking place even with very coarse feed. Circulation and agitation of the pulp is accomplished by a rubber-covered impeller, 8 in. in diameter, which causes air to be drawn through the hollow shaft and out of the ports immediately behind the backs of the impeller blades where cavitation takes place. Aëration is said to be effected with an economy of power that is not possible at a greater depth where hydrostatic pressure is greater and a higher speed of rotation would be required to obtain cavitation. The air is intimately mixed with the pulp by the impeller and the rubber-covered deflector blades above it. Uniform distribution of the upwardly moving, aërated pulp is effected by the distributing cone and the perforated plate immediately above it. These parts are so designed as to cause gradual diminution of velocities above the impeller, facilitating the segregation of the mineral-laden bubbles from the pulp.

Part of the pulp is recirculated as it moves downward and joins the feed entering the intake tube. The descending pulp in that part of the cell where the cross-sectional area is large, travels at a low velocity for a long period of time. This affords optimum conditions for de-aëration. The design of the impeller is such that the air from each port is introduced above the leading edge of the blade following, and at a sufficient height that it in no way interferes with the pumping action of the impeller regardless of the amount of air introduced. The only elements that are said to be subjected to appreciable wear are the impeller and the deflector blades. Both of these are rubber-covered. At one mill, it is reported, there has been no replacement of wearing parts in a period of fifteen months' continuous operation.

Full load of pulp may be passed through the machine while one cell is being serviced. High-pressure air or water jets placed in each cell are provided to permit keeping the pulp in circulation during such an emergency shutdown of one cell, for servicing the rotor assembly. These jets can also be used when starting up of the machine after a long shutdown, if all the pulp contained in the machine at the time of the shutdown has been allowed to settle, or for keeping the pulp in circulation during a temporary power failure. Entire rotor assembly, for any cell, can be replaced within six to ten minutes without the necessity of turning off the feed to the machine.

The amount of air that can be drawn in by the impeller at its normal speed of rotation is said to be adequate for any flotation requirements. The rate of froth discharge is controlled by the "crowder" A (see cut), which may be easily adjusted vertically to vary the free surface area of the cell. The height of the weir over which the froth discharges can be varied by inserting bars of different heights. Control of the froth discharge rate, the amount of air introduced, and the height of froth overflow lip, all within easy reach of the operator, enable him to govern the amount, the depth, and the character of froth for the entire bank of cells as well as for individual cells. Ores containing large amounts of mineral to be floated, as well as those yielding a very high ratio of concentration, are reported efficiently handled.

The manufacturer lists the following important operating features: Capacity, 250 tons per cell per day on an ore requiring eight minutes' contact period in a pulp carrying 30 per cent solids. Power required, 3 hp. per cell, or less than 0.3 kw.-hr. per ton of ore treated for most ores. Floor space required, less than half that needed for any other equipment of equal capacity.

New Rock-Bit Grinder

A ROCK-BIT GRINDER designed for the user of a limited number of bits has recently been announced by the Mine & Smelter Supply Company, Denver, Colo. The new unit, known as the Massco Junior rock-bit grinder, is so designed that any one can soon learn the few easy steps of grinding the gage to the correct angle and sharpening the cutting edges in two or three minutes per bit. This means that detachable bits can be kept sharpened for top efficiency also at the small mine repair shop. Adjusting screws are provided for positioning the bit for grinding the gage to the desired clearance angle and size, and to provide the right angle of contact of the cutting edges against the wheel, a feature so necessary to grinding a bit for the best drilling efficiency, and one not usually found on this type of grinder. The Massco Junior grinder is furnished as a complete unit or as attachments to fit on any bench or pedestal grinder. Latter can be easily and quickly installed in front of the wheels on the bench or on the base plate of the pedestal grinder.

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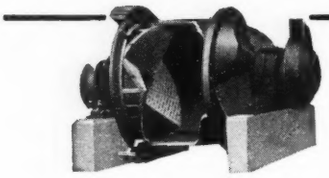

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SEND for particulars and let our many years' experience help you with your grinding problems.

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582 Market St. San Francisco, Calif.

A Dry Method of Ore Concentration

NEW YORK Concentrators, Ltd., Suite 3411, R. C. A. Building, Rockefeller Center, New York City, N. Y., announced late in 1938, the development of a new non-mechanical air separator or concentrator for the close separation of minerals or materials of different specific gravities, as well as for the classification of materials of a similar specific gravity by sizes. The machine has been introduced under the name of the "Schramm System" of dry concentration, and is said to be specially adapted for mines in arid regions. The principle employed by the "Schramm System" is based on the movement of solid particles in a rising air column; that is, if solid particles are all of the same size, but of different specific gravities, the more dense or heavier particles will settle against the rising medium or air column, whereas the least dense or lighter particles will rise. In commercial practice this principle is employed by preparation of the ores or materials by crushing, grinding and screening. The grinding is carried out as close to granulation as possible, this granulated product then being fed to a series of Diester Multirap Vibrator screens. The number of screens sizes necessary depends on how great an increment of difference is in the specific gravities of the materials to be separated. The smaller this increment, the closer is the screening necessary and vice versa.

To illustrate the operation, an ore having its values released at 80 mesh would be concentrated on all meshes, but up to 80 mesh the tailing would be recirculated for further grinding. The final tailing of the operation would all be the tailing product of the —80 mesh concentrators. This is said to afford concentration of all values as soon as they are released from the gangue. The system results in the production of a dry concentrate.

The concentrator consists of a vertical cylindrical column, constructed of sheet metal with an incased particle distributor and vacuum chamber. Separation is effected by a rising air medium constant throughout this column. The material is fed into the center of the column and on to a central static distributor. The particles are said to fall over a series of such distributors, thus allowing each particle to rise with the air column or fall against it. Then the rising product is fed automatically to a recirculation vacuum chamber which allows the heavier particles, of the light product, to be redistributed into the air column and affords a recleaning action. The finished light product is carried out of the concentration chamber over to a cyclone collector, where it settles and discharges through a series of pressure-balanced gates as final tailing.

In this device the complete air column is activated by a blower, and control of this air velocity is made by a hand-regulated valve and is read direct by manometer readings of air pressures. Once these readings are said to be established on a specific material of any single mesh size, they never vary.

The concentrator is simple in construction, having no moving parts; is light in weight, and is said to have low operation cost. The unit can be easily assembled and moved by rail or truck or airplane transport.

Portable Flare Lights

ALEXANDER MILBURN COMPANY, 1493 West Baltimore St., Baltimore, Md., announces the addition to its line of three portable flare lights. These flares are designed to be used by contractors, railroads, street railways and all industries working outdoors at night. They are furnished in three sizes, as follows: No. 10T: For use with Type MC, 10-cu.ft. Prest-O-Lite acetylene tanks. Equipped with 10-in. aluminum reflector, tank connection, swing joint and stand pipe. Over-all height, including tank, 30 in. No. 40T: For use with Type B, 40-cut.ft. Prest-O-Lite acetylene tanks or tanks of similar size. Equipped with 13-in. aluminum or porcelain reflector, tank connection, swing joint, and stand pipe. Over-all height, including tank, 40 in. No. 150T: For

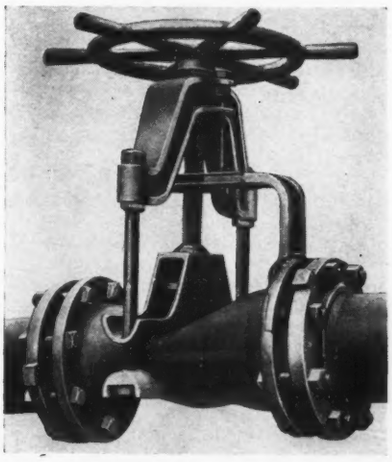
use with standard 150-cu.ft., or larger, acetylene tanks. Equipped with 13-in. aluminum or porcelain reflector, tank connection, swing joint, gas cutoff cock, and standpipe. Over-all height when used with standard 150-cu.ft. acetylene tank, 66 in.

The Marion Steam Shovel Company, Marion, Ohio, announces a new 1-cu.yd. shovel readily convertible to dragline, crane, clamshell, or pull shovel. It is said to incorporate modern features of design and construction and is built for speedy operation

Stamp Mill

A NEW STAMP mill is announced by Roland M. Gruss, care of San Francisco Engineering Company, 322 Sixth St., San Francisco, Calif. The unit consists of two stamps that are said to be rocked up and down at a speed ranging from 200 to 400 drops per minute. The stamps weigh 250 lb. each and can be adjusted for crushing soft or hard ores. The complete unit is said to weigh 2,000 lb., is 6 ft. high and occupies a floor space of 6x5 ft., and the heaviest part when disassembled is said to weigh only 100 lb. At a speed of 400 drops per minute the mill can be operated on 2 hp.

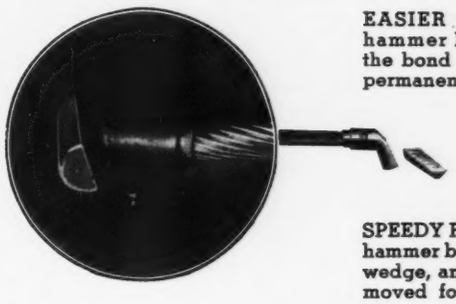
Pinch Valve



MINE & SMELTER Supply Company, Denver, Colo., has introduced the Massco-Grigsby pinch valve, said to be of new design, consisting of a special rubber sleeve to regulate or stop the flow of liquid through the valve. The rubber sleeve is reinforced with heavy fabric to withstand a pressure up to 150 lb. To prevent cracking when the valve is closed, two recesses have been molded into the inside walls, diametrically opposite each other. Regular sizes of the new valve are 4, 6, and 8 in.

TWO EASIER METHODS TO BOND YOUR TRACK

1 The New Wedge-Type Rail Bond



EASIER INSTALLATION—A few hammer blows on the wedge and the bond is installed positively and permanently.

LOW RESISTANCE—Provides shortest possible rail-to-copper-to-rail path. Cold-forged all-copper terminal minimizes power loss.

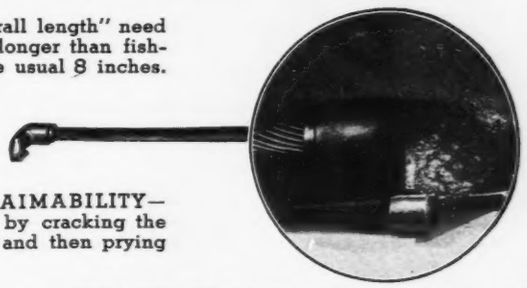
SPEEDY RECLAIMABILITY—Several hammer blows on the small end of the wedge, and the terminal is easily removed for inspection or re-installation.

LOW COST—"Overall length" need only be 6 inches longer than fish-plate. Economically installed and reclaimed.

2 The O-B AW-20 Steel Arc-Weld Bond

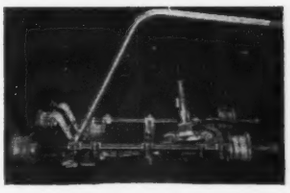
LOW COST—"Overall length" need be only 6 inches longer than fish-plate instead of the usual 8 inches.

LOW RESISTANCE—Minimum length and short copper-to-rail path reduce power losses.



POSITIVE RECLAIMABILITY—Quickly reclaimed by cracking the weld with a chisel and then prying off terminal.

EASIER INSTALLATION—Only 1¼ inches of weld per terminal are needed. Weld is made on easily accessible outside edge of terminal.



The WEDGE-BOND RAIL DRILL

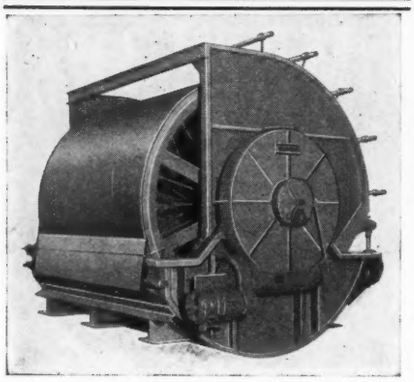
For properties who do not drill their rail to specification at the mill, O-B engineers have developed this portable electric rail drill, adjustable to all weights of rail. Both holes may be drilled in less than three-quarters of a minute.

2080-M

OHIO B BRASS

MANSFIELD OHIO · U·S·A

Canadian Ohio Brass Company, Ltd. · Niagara Falls, Ont., Canada



CONTINUOUS - VACUUM

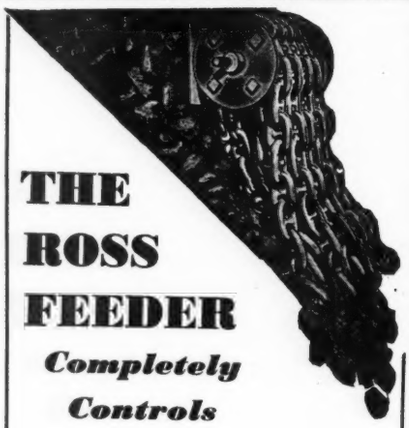
FILTERS

● Illustration above shows Eimco Drum Filter recently furnished to large Canadian gold mining company for washing and dewatering cyanide slimes. Many other installations throughout the entire mining world are giving *better results, at very much less expense for operation and maintenance* than has ever before been possible.

● Bulletin 401 gives complete information regarding Eimco's modern, new-feature drum and disc filters. Write today for free copy and tell us about any present or prospective filtration requirement. Our laboratory tests, recommendations, and estimates involve no charge or obligation—may easily help you to achieve important savings.

The EIMCO Corporation

SALT LAKE CITY, UTAH, U.S.A.



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ROSS SCREEN & FEEDER CO.

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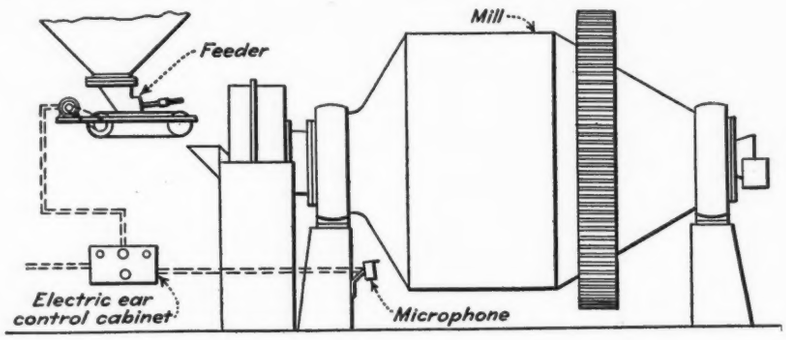
2 Victoria Street, London, S.W.I., England

"Electric Ear," for Operating Grinding Mills By Their Sound

SOUND has been used to control the operation of grinding mills manually for many years, but not until the advent of the Electric Ear has it been possible to control the mill automatically by the sound coming from the mill itself.

The Hardinge Electric Ear, announced by the Hardinge Company, York, Pa., is a device that is said to control mill operation automatically. In principle it reduces the rate of feed when the noise from the mill drops an infinitesimal amount below a predetermined noise level and increases the rate of feed when the sound from the mill is slightly above the desired noise level.



The complete unit consists of a control cabinet, and a microphone with protecting shield and cover, having sound insulated back. The Electric Ear control circuit is energized by the ordinary electric-light current. The microphone is located close to the mill, with the power relay in the control cabinet and the power line to the feeder motor. In operation the unit is first connected into the light circuit and measurement of the noise level of the mill is recorded by reading the meter on the control panel before the power relay is connected into the feeder circuit. There is only one adjustment in controlling the Electric Ear and that is a dial and knob located on the control panel. This regulates the noise level of the mill. The sensitivity of the Electric Ear is regluated so that the power relay will close at the desired noise level.

Without shutting down the mill, connection is made from the feeder with the power relay, which usually requires one or two minutes. The feeder is then reset so that the normal feed rate is increased 0 or 30 per cent. This increase in a short time tends to load up the mill, but immediately the sound level of mill drops an infinitesimal amount, due to this increased load, the power relay opens and the feed shuts off or is reduced. When the noise level increases slightly, the relay is closed and the feed is then increased or the feeder started up. The Electric Ear control circuit is said to be responsive to infinitesimally small changes in noise level and yet is sturdy and simple in construction. The unit is applied on dry grinding and wet grinding mills, in open and closed circuit with the standard types of classifiers. By controlling the noise level when grinding in open circuit, the fineness can be changed and the mill kept from overloading, even though the hardness of feed changes and the size varies, due to bin segregation or other causes. When grinding in closed circuit, either wet or dry, with screened air classifiers or wet mechanical classifiers, the fineness can then be controlled independently of the noise level within the limit of capacity of the mill, and in this case the Electric Ear controls the feed so that maximum capacity at the desired fineness is maintained under all operating conditions. By the use of the Electric Ear the best grinding rate is said to be determined within limits not heretofore possible by manual operation, with a resultant increase in capacity, said usually to be in excess of 10 per cent.

In wet grinding, it is said that with the addition of an electrically operated valve which is controlled by the Electric Ear, and the use of the Hardinge Constant Weight Feeder, densities may be maintained uniform, regardless of the feed rate or conditions of operation—a desirable feature, and particularly when it comes to maintaining uniform fineness and proper conditions of overflow, which affect subsequent processing.

INDUSTRIAL NOTES

The Stearns Magnetic Manufacturing Company, of Milwaukee, Wis., has concluded arrangements with the Exolon company, of Blasdell, N. Y., whereby the Stearns organization will manufacture and sell Exolon machines, according to a recent announcement from R. H. Stearns, president of the Milwaukee firm.

Sullivan Machinery Company announces the election of Frederick W. Copeland as president. Mr. Copeland has resigned the presidency of the H. Channon Company, Chicago, to take over his new duties. He was previously connected with the Sullivan Machinery Company, having joined the organization in 1913. In the 21 years which followed, he worked successively as apprentice in each plant, service man in the mines, salesman, export manager, vice-president, and controller. He has been a director of the company since 1923. In 1934 he left to become president of the Channon company.

Erling Winsnes, manager since 1930 of Sociedad Manufacturers, Allis-Chalmers' principal district office at Santiago, Chile,

DEISTER'S

Latest Improvements In

PLAT-O ORE CONCENTRATING TABLES for concentrating any ore from ¼" to slimes. *Bulletin No. 20B.*

PLAT-O HEAVY DUTY VIBRATING SCREENS for large tonnages ore, sand and gravel, crushed stone, etc. *Bulletin No. 26.*

MULTIRAP VIBRATOR—High speed for fine screening. Non-blinding, high efficiency, long life screen cloth. *Bulletin No. 24.*

COMPOUND FUNNEL CLASSIFIER—Gold trap for coarse gold. Preparation of ore pulps for table concentration. *Bulletin 23.*

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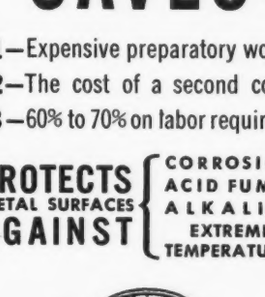

WRITE

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THE NITROSE COMPANY, INC.
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has been appointed by that company as manager for the entire continent of South America, effective Jan. 1, with offices at Calle Peru 571-583, Buenos Aires, Argentina, S.A. R. E. Diaz has been appointed manager of Allis-Chalmers district office at Santiago, Chile, to succeed Mr. Winsnes. Mr. Diaz has been connected with this office for many years as sales engineer and will continue his headquarters at Edificio Mutual de la Armada, Santiago de Chile. Ernest Smith will remain in charge of operations in Bolivia, with offices at Esquina Sucre y Linares in Oruro. W. Gerard Boulton will continue in charge of Allis-Chalmers operations in Argentina, Uraguay, and Paraguay with office at Calle Peru 571-583, Buenos Aires, Argentina.

General Engineering Company, of Salt Lake City, Utah, has opened a branch office in the Rialto Building, San Francisco, Calif., in charge of R. H. Lowe.

By a consent decree in the United States District Court of Colorado in the case of Oliver United Filters, Inc., vs. Morse Brothers Machinery Company, judgment was entered for the plaintiff and an injunction was issued on Nov. 19, 1938. From that date until May 15, 1942, the defendant is enjoined from advertising or selling under the names "Oliver" or "American" or "Oliver Type" or "American Type" any filter manufactured by anyone other than the plaintiff; and from manufacturing, advertising, or selling any filter infringing on Letters Patent No. 1,538,980 and No. 1,593,051 without consent of the plaintiff. No accounting was ordered in view of the amicable settlement of the matter.

BULLETINS

Rock Bit Grinders. Mine & Smelter Supply Co., Denver, Colo. Two-page folder illustrates and describes the Masco Junior rock bit grinders developed recently, which are furnished as a complete unit or as attachments to fit on any bench or pedestal grinder.

Car Pullers, Hoists, and Winches. Stephens-Adamson Mfg. Co., Aurora, Ill. Catalog 7738 describes and illustrates units for the above purposes and gives specifications, dimensions and engineering information on how to select proper car puller. Pp. 8.

Gyrating Screens. Denver Equipment Co., Denver, Colo. Bulletin 38-S 3 illustrates and describes the manufacturer's various gyrating screens, single, double, or triple deck units. Pp. 4.

Portable Compressors. Ingersoll-Rand, Phillipsburg, N. J. Booklet 3364 describes and illustrates a new line of two-stage, air-cooled portable compressors for mining and other industrial uses. Pp. 32.

Heavy-Duty Mine Dewatering Pumps. Pomona Pump Co., Pomona, Calif. Bulletin 27 has comprehensive information for mine operators having pumping problems. Illustrations and diagrams are given showing various installations in dewatering mines or mine drainage. Pp. 15.

Placer Jigs. Pan-American Engineering Co., 820 Parker St., Berkeley, Calif. Bulletin PM describes features of placer jigs of different sizes for use in mills and in placer operations. Pp. 4.

Mine and Quarry Machinery. Smith Engineering Works, Milwaukee, Wis. Bulletin 266-L describes specifications and illustrates various machinery for use in crushing, screening, trommels, log washers, scrubbers, classifiers, and feeders. Pp. 34.

Pumps. Peerless Pump Division, Food Machinery Co., Los Angeles, Calif. Bulletin 142 describes and illustrates a new "Hi-Lift" pump, said to be of new design and principle, based on "squeezing" water along to its destination rather than to rotate and centrifugally elevate it. Pp. 4.

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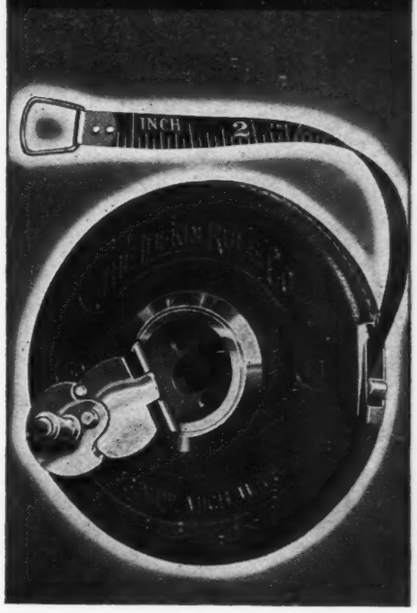

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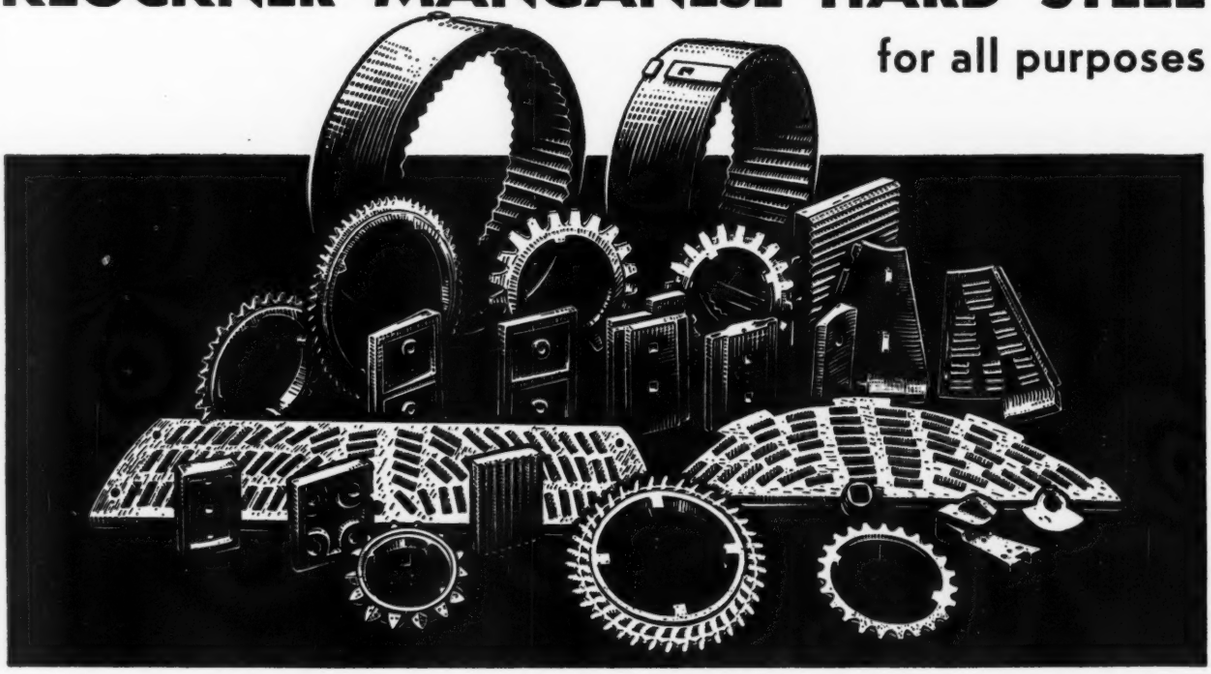

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